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No. 126, Original

In The
Supreme Court of the United States

DEPOSITION OF STEVEN P. LARSON

STATE OF KANSAS,

Plaintiff,

v.

STATE OF NEBRASKA

and

STATE OF COLORADO,

Defendants.

Wednesday, February 15, 2012

8:12 A.M.

PURSUANT TO NOTICE and the Federal Rules of Civil Procedure, the above-entitled deposition was taken on behalf of Defendant State of Nebraska at 1525 Sherman Street, 7th Floor, Denver, Colorado, before K. Michelle Dittmer, Registered Merit Reporter and Notary Public within Colorado.

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5 Jasper Fanning
Brian Dunnigan
6
Also Present via telephone: Sam Perkins
7 Alex Spiliotopoulos
Chris Beightel
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25

1 P R O C E E D I N G S

2 STEVEN P. LARSON,

3 having been first duly sworn, was examined and

4 testified as follows:

5 (Mr. Beightel was not present via telephone

6 at the commencement of the proceedings.)

7 E X A M I N A T I O N

8 BY MR. WILMOTH:

9 Q Good morning, Doctor. How are you today?

10 A Good morning.

11 Q Just for the record, could you please state

12 and spell your full name.

13 A My name is Steven P. Larson. Steven,

14 S-T-E-V-E-N, Larson, L-A-R-S-O-N.

15 (Speakerphone beeped.)

16 THE DEPONENT: Did somebody just join?

17 Q (BY MR. WILMOTH) Dr. Larson, I'm going to

18 hand you a copy of the Notice of Deposition, which we'll

19 mark as Exhibit 1 and just ask if you've seen this

20 document before.

21 (Deposition Exhibit 1 was marked.)

22 A Yes, I have.

23 Q Did you bring any supplemental materials

24 pursuant to the request on page 2?

25 A We did bring some.

1 MR. DRAPER: Tom, we have -- in reviewing
2 his report, we found that one of the tables referred to
3 in the report was left out, so I have some replacement
4 pages.

5 MR. WILMOTH: Okay.

6 MR. DRAPER: And so we're prepared to give
7 those to you right now, if you'd like.

8 MR. WILMOTH: All right.

9 MR. DRAPER: -- or when we get to that area
10 of the report.

11 MR. WILMOTH: Why don't we take those now.

12 MR. DRAPER: Okay.

13 MR. WILMOTH: And we'll mark those as
14 Exhibit 2.

15 MR. DRAPER: The absence of Dawn is
16 manifesting itself once again. That could be the record
17 copy.

18 MR. WILMOTH: Can we mark this as a single
19 exhibit, John?

20 MR. DRAPER: I think it's probably most
21 efficient to do it that way.

22 MR. WILMOTH: All right. So that will be
23 Exhibit 2.

24 MR. DRAPER: Here's a copy here.

25 (Deposition Exhibit 2 was marked.)

1 MR. DRAPER: Here it is with the table at
2 the back. I can put together another set for you if
3 that would help.

4 MR. WILMOTH: That would be helpful.

5 Q (BY MR. WILMOTH) Is that the only
6 additional or supplemental document that you brought,
7 Doctor?

8 A Mister, yes.

9 Q Mister, excuse me.

10 Can you tell me whether there are any
11 narrative or textual changes in this document, or is it
12 simply the addition of a table?

13 A There is a reference to the table. It
14 turned out, in the original report, there were two
15 references to Table 1, so we changed the one reference
16 to Table A, to avoid confusion with the existing
17 Table 1.

18 Q Okay.

19 A And that was the only text changes. Then
20 we added, in the list of tables, Table A.

21 Q Okay. And just for the record, would you
22 mind underscoring the new material or the modified
23 material?

24 MR. DRAPER: I should -- while he's doing
25 that, Tom, it might be helpful for me to mention that

1 the information in the table was included in the backup
2 that was provided to Nebraska on November 18. It just
3 didn't get put in the table.

4 A And with regard to the table itself, I'm
5 not going to underscore it.

6 Q (BY MR. WILMOTH) Thank you, Mr. Larson.

7 Before we proceed any further, Mr. Larson,
8 are you currently suffering any ailment or are you on
9 any medication that would preclude you from testifying
10 truthfully and accurately today?

11 A No.

12 Q Thank you.

13 I'm going to hand you a copy of your
14 curriculum vitae, which we will mark as Exhibit 3 to the
15 deposition.

16 (Deposition Exhibit 3 was marked.)

17 Q (BY MR. WILMOTH) I just ask if you could
18 identify this document as such?

19 MR. WILMOTH: Pete, I'm sorry. I didn't
20 bring additional copies. I think you've got everything
21 that we're going to be looking at.

22 MR. AMPE: Okay.

23 A Yes, this is a copy.

24 Q (BY MR. WILMOTH) Okay. Thank you very
25 much. And is your complete educational background set

1 forth on your CV?

2 A Yes, it is.

3 Q Do you have any additional professional
4 certifications, such as professional engineer?

5 A No.

6 Q Is your complete professional background
7 listed on this CV, or is there anything you would like
8 to supplement?

9 A Well, it provides a summary of my work. I
10 think generally it's reasonably complete. Obviously I
11 don't outline everything I've done in the last 40 years,
12 but it's reasonably complete.

13 With respect to the deposition and
14 publications, it follows the Federal Rule limitations of
15 ten years and four years.

16 Q Very well.

17 As far as the issues material to this
18 matter, you believe that they're reflected here, the
19 education and professional background material to the
20 issues at bar today are summarized here?

21 A I think generally speaking, yes.

22 Q All right. Can you explain to me what a
23 Certified Professional Hydrologist is?

24 A The American Institute of Hydrology will
25 provide this certification based on either an exam or

1 based on your professional experience. And then they
2 have different classes of hydrologists that they certify
3 in terms of specialties, whether you're in groundwater,
4 surface water.

5 Q Did you test in or did you qualify through
6 your experience?

7 A I qualified through my experience and also
8 through references from other hydrologists.

9 Q And do you possess a subclassification,
10 like the one you referenced?

11 A Yeah. My classification is hydrologist
12 specializing in groundwater.

13 Q And what experience or coursework led to
14 that certification?

15 A You had to submit, obviously, information
16 about, you know, your experience, your education and
17 references from other people that could vouch for your
18 experience. So it was basically just a list of,
19 basically, your CV.

20 Q So information comparable to what's in
21 front of us here as Exhibit 3?

22 A Yeah. I don't remember offhand how much
23 more detailed information I had to submit at the time.

24 Q Does the American Institute of Hydrology
25 publish any standard journal or articles?

11

1 A Not that I know of.

2 Q Do you know if they participate in any type
3 of peer review process for scholarly articles or
4 publications?

5 A Not that I recall.

6 Q What is the main purpose, as you understand
7 it, of that institute?

8 A Well, it's a group of -- it's a
9 professional organization associated with hydrology,
10 basically.

11 Q Do they put up conferences or --

12 A Yes.

13 Q -- continuing education?

14 A Yeah.

15 Q Is there any continuing education
16 requirement for maintaining your certification?

17 A I think there generally is. I don't
18 remember the specifics of it, but generally speaking,
19 there is.

20 Q Do you participate in any -- any of that?

21 A Well, I keep my certification current.

22 Q I also noticed that you served at the U.S.
23 Geological Survey at one point. Could you explain what
24 you did for the Survey?

25 A Well, my first job was in Denver, Colorado.

12

1 I spent about six months in a training program for new
2 hires at the time. That was a long time ago.

3 I was -- I then spent about three years in
4 the district office of the water resources division in
5 Minnesota, basically conducting various kinds of
6 groundwater, surface water studies.

7 And then I was transferred to the
8 headquarters of the U.S. Geological Survey in Reston,
9 Virginia in 1975. I spent about four more years there,
10 four or five more years there, basically working in
11 their research group dealing with groundwater modeling,
12 basically developing groundwater models, providing
13 training courses for other hydrologists in the use of
14 groundwater models.

15 And also I served as a -- sort of a
16 consultant, if you will, to people who were applying
17 these models in the various district offices throughout
18 the country.

19 Q What types of models did you typically
20 develop or employ while at USGS?

21 A Well, the principal one that I worked on at
22 the time was -- there was a two-dimensional groundwater
23 model that Peter Trescott and George Pinder had
24 developed, and I got involved with that. And at that
25 time, that was sort of the state of the model --

13

1 modeling practice at that time.

2 Peter Trescott --

3 Q The 2D part, is that what you're referring
4 to?

5 A Two-dimensional groundwater model, yeah.

6 There was a training manual that was prepared by the
7 USGS with regard to that model.

8 Peter Trescott, when I first went there,
9 was working on developing a three-dimensional version,
10 so then I started working with Peter. And we worked
11 together to develop a three-dimensional groundwater flow
12 model that was being used -- it began to be used
13 throughout the USGS; I think it's probably outside as
14 well.

15 Q Does that model have a name?

16 A I don't think it had a formal name, like
17 MODFLOW, for example. It was sometimes referred to as
18 the Trescott-Larson model, perhaps, but --

19 Q Is it still in use by USGS, do you know?

20 A Not that I know of.

21 Q What were the advantages of the 3D version
22 over the 2D version?

23 A The 3D version provided the ability to
24 look, first of all, at the vertical dimension, as well

25 as the lateral dimensions, although the 2D version could

14

1 be used to look at cross-sectional profiles. But
2 basically it gave you a three-dimensional capability,
3 plus it provided the ability to look at multilayer
4 aquifer systems.

5 Q And what is the value in being able to
6 evaluate multilayer aquifer systems?

7 A Well, if the aquifer system has
8 multilayers, and they need to be considered for whatever
9 problem you're looking at, then you would be able to
10 consider them.

11 Q Are there aquifers that don't contain
12 multilayers at some point, either they're too shallow or
13 just uniquely situated?

14 A I'm not sure I understand the question.

15 Q Do all aquifers contain multiple layers?

16 A Not necessarily.

17 Q What aquifers typically contain only
18 uniform layers?

19 A Well, if you had a -- say, an alluvial
20 outwash aquifer system, it may be all just sand and
21 gravel.

22 Q So your 2D model, I suppose, would be
23 effective in that case?

24 A Well, it depends on what you're doing.

25 Q Would you prefer to use a 3D model in that

15

1 case?

2 A It depends on what problem you're trying to
3 solve.

4 Q What is the nature of the aquifer
5 throughout the Republican River Basin?

6 A It's basically considered to be -- well, at
7 least on a regional scale, I think you could consider it
8 to be a single-layer aquifer. It's overlain by
9 relatively low permeability materials that tend to not
10 contribute much to the overall process, and you can
11 effectively simulate it as a single-layer system.

12 Q So do you presently employ a 2D or a 3D
13 model in your work concerning the Republican River?

14 A The RRCA Groundwater Model uses MODFLOW,
15 which has the capability to look at three dimensions,
16 but it's being applied at two dimensions.

17 Q So do I understand that you performed
18 services as an educator or a trainer for USGS with
19 regard to model usage?

20 A Yes.

21 Q Did you have a preferred model that you
22 employed during that period or was it this one that you
23 referred to as the Trescott-Larson model?

24 A Well, there were -- there were probably
25 several. One of them was the two-dimensional model. At

16

1 times we gave courses about that. At times -- in fact,
2 I think the first courses that I gave dealt with that
3 model.

4 Then we also had courses dealing with a
5 three-dimensional and multilayer model that I
6 participated in. And then there were courses dealing
7 with a version of the two-dimensional model that I had
8 independently put together to link up with a
9 parameter-estimation procedure that was being developed
10 by Dick Cooley at the time, and I also gave courses on
11 that.

12 And there was a freshwater/saltwater
13 interface model, but I don't think that we ever gave any
14 courses on that that I can remember.

15 Q Were there any standard cautions or
16 concerns that you attempted to convey to your students
17 with regard to the usage of models as to their
18 capabilities or functions?

19 A Well, we would explain what the model was
20 capable of doing, and we would explain how the model was
21 structured. And they could make decisions about whether
22 it was applicable to their problems or not.

23 Q How would you make that determination
24 generally? What criteria do you use to determine how to
25 apply a particular model to a particular problem?

1 A I don't think there is specific criteria.

2 I think that's, in part, what being a hydrologist
3 entails, is being able to determine what kind of
4 analysis is appropriate for what kind of a problem.

5 Q So, in other words, does that mean it's a
6 case-by-case basis, essentially?

7 A Is what a case-by-case basis?

8 Q Determining which model to apply to a given
9 problem; is that a case-by-case question to be answered?

10 A Yeah. I think it depends on the question
11 and it depends on your judgment about whether a model
12 would be useful in answering the questions.

13 Q What do you think is the question to be
14 answered by the Republican River Groundwater Model?

15 A The questions to be answered by the
16 groundwater model are to try to estimate the amount of
17 groundwater depletions associated with pumping by each
18 of the different states and to provide an estimate of
19 the effect of the imported water supply associated with
20 the canal seepage from importing water from the Platte
21 River and provide an estimate of those effects to be
22 used through the accounting procedures.

23 Q And does that have a broader objective of
24 defining the virgin water supply or are those inputs
25 into the virgin water supply calculation?

1 A I believe that as those -- that information
2 is taken into the accounting process, that information,
3 along with other information, is used to make that
4 calculation. That's my understanding, yes.

5 Q So if either one of those calculations is
6 incorrect, is the virgin water supply calculation
7 ultimately incorrect?

8 A Well, since nobody knows what the true
9 virgin water supply is, it would be hard to determine
10 whether it would be correct or incorrect, but these are
11 the estimates that are provided to that process and
12 they're estimates.

13 Q So you're suggesting that no one can ever
14 really know what the virgin water supply is?

15 A There are ways to make estimates, and
16 that's what the process tries to do is make estimates.

17 Q If one of those estimates, though, is
18 incorrect, what's the effect on the virgin water supply?

19 A Well, since I don't know what the true
20 virgin water supply is, I wouldn't be able to determine
21 what the effect is.

22 Q You were present yesterday at Dr. Wilson's
23 deposition, were you not?

24 A I was.

25 Q Did you hear him testify as to the quality

1 of the groundwater model?

2 A The quality of the model? What do you mean
3 by that?

4 Q Well, Kansas counsel asked a series of
5 questions about whether the model was sufficient for its
6 purpose. Were you present then?

7 A Yes.

8 Q Did you hear those questions?

9 A Yes, I did.

10 Q How would you characterize the quality of
11 the groundwater model?

12 A Can you explain to me what you mean by "the
13 quality of the groundwater model"?

14 Q How would you characterize its ability to
15 perform its function?

16 A I think it provides reasonable estimates
17 for purposes of the accounting process.

18 Q Are you aware of any instances in which the
19 model indicates that water should be available at a
20 location when, in fact, it physically is not present?

21 A I'm not understanding the question.

22 Q Are you aware of any situations where the
23 model indicates water should be present where it
24 physically, in fact, is not?

25 A Are you saying, am I aware of places where

20

1 the model predicts some flow and that the measurements
2 of flow say it's not there?

3 Q Yes.

4 A Not offhand. I mean, there may be some,
5 but I'm not specifically aware of one.

6 Q How about the inverse: Where the model
7 actually predicts there would be no flow, but there
8 actually is in physical reality?

9 A In terms of actually looking at measured
10 flows? Now that I think about it, there probably are
11 instances of both of those in the calibration process.

12 Q Can you tell me about the work you do
13 through S.S. Papadopoulos -- am I pronouncing that
14 correctly?

15 A You are.

16 Q Who are the firm's biggest clients? Let's
17 say the top three.

18 A Top three. Well, we've done -- one of the
19 bigger clients is associated with the Hanford Military
20 Reservation in Washington.

21 Q What's the nature of that work?

22 A It deals with cleanup of contamination at
23 the Hanford Reservation.

24 Q Would that be groundwater contamination
25 or just --

1 A Groundwater contamination, yes.

2 That's the one that sticks in my mind. I'm
3 not sure I can come up offhand with any ranking of the
4 other big clients.

5 Q How would the State of Kansas sit, in your
6 view, as to its status among your clients in terms of
7 size?

8 A In terms of size, it would be relatively
9 small, but they've been our client for a long time.

10 Q How much work have you performed for the
11 State of Kansas over the years, would you estimate?

12 A Well, I can only tell you that I began
13 working for them probably in the mid 1980s on things,
14 and I've been working for them on and off since that
15 time.

16 Q Could you list the projects for which you
17 have performed work for Kansas?

18 A Well, I think the first one was associated
19 with the Arkansas River, so I worked on that project for
20 a long time. Still, I guess, from time to time they do
21 something, although we're not actively doing anything at
22 the moment.

23 Then I work on the Republican River
24 project. We also had a couple of small projects to
25 develop some models in the Solomon River Basin.

1 And then I acted on their behalf on sort of
2 a technical review committee, if you will, reviewing
3 some modeling exercises at some of the other groundwater
4 management districts in Kansas. There were about two or
5 three of those where I provided just technical review of
6 work done by others.

7 Q Anything else?

8 A That's all I can remember right now.

9 Q What percentage of your time specifically
10 would you say has been devoted to those issues over the
11 last, say, five years?

12 A I would say not very much. I couldn't give
13 you a hard number, but it wouldn't be very much.

14 Q What was the nature of the work you
15 performed in the Arkansas Riverbed?

16 A Initially, when Kansas was preparing to
17 file their claim, I assisted the attorneys in preparing
18 information to submit with their filing.

19 And then when the case began, our company,
20 although it wasn't me personally at first, began to
21 develop the model that was going to be used to evaluate
22 impacts along the river system, which is now called the
23 Hydrologic-Institutional Model.

24 As the case progressed, I became part of a
25 team of experts that continued to develop the H-I Model

1 and then provided testimony in the proceeding before the
2 Special Master over a series of years, basically dealing
3 with the Hydrologic-Institutional Model.

4 And I also provided some testimony on some
5 of the evaluations of streamflow and other conditions
6 along the river as part of my expert work in that case.

7 Q Is the Hydrologic-Institutional Model, or I
8 believe you called it the H-I Model, is that a
9 MODFLOW-based model?

10 A No.

11 Q What is the fundamental difference between
12 that model and the RRCA Model?

13 A Well, the RRCA Model is purely a
14 groundwater model. The Hydrologic-Institutional Model
15 has a groundwater component to it, but it also includes
16 surface water operations and routing through the surface
17 water system.

18 Q And with regard to the groundwater
19 component of the H-I Model, how does that compare to the
20 RRCA Groundwater Model?

21 A Well, the groundwater component of the H-I
22 Model is included through a series of response functions
23 that were developed from another groundwater model, and
24 so the H-I Model itself actually operates on using those
25 response functions and were developed from the original

24

1 groundwater -- from a groundwater model.

2 Q What was the original source model?

3 A It was a finite element model,

4 two-dimensional finite element model. And then some of

5 the -- some of the response functions, I think, were

6 based on some general analytical models associated with

7 some of the -- I think they were called bench aquifers

8 at the time.

9 Q Does the H-I Model, groundwater component,

10 function to determine the impact of groundwater pumping

11 and other depletions on the river? Is that its role?

12 A Its role is to deal with groundwater-

13 surface water interaction along the stream system and to

14 keep track of those interactions.

15 Q So it doesn't take into account groundwater

16 pumping?

17 A No, it does.

18 Q It does?

19 With regard to its ability to account for

20 the effects of groundwater pumping, how would you

21 compare it to the RRCA Groundwater Model?

22 A Well, generally, it's based on sort of the

23 same principles of conservation of mass, for example.

24 The response functions are developed from a groundwater

25 model that is based on Darcy's Law.

1 So in that respect, they're similar,
2 although the groundwater system that's included in the
3 H-I Model is largely an alluvial system that runs along
4 the river network with the exception of some of these
5 bench areas.

6 Whereas the Republican River Groundwater
7 Model is a large regional aquifer model of Ogallala and
8 alluvial areas combined.

9 Q Given that, do you consider the H-I Model
10 to be more responsive, if you will, to changes in
11 pumping than the RRCA Groundwater Model?

12 A And what do you mean by "responsive"?

13 Q Do you find that changes in pumping are
14 more easily manifested through the model, the H-I Model,
15 than the RRCA Groundwater Model and their effects on the
16 river?

17 A I would say, generally speaking, that
18 the -- that with respect to the H-I Model, that
19 groundwater impacts or pumping impacts are -- affect the
20 river more rapidly than at least some of the impacts
21 that we have in the RRCA Groundwater Model.

22 Q And can you tell me why that is?

23 A Well, it's a function of distance. It's a
24 function of transmissivity. It's a function of storage.

25 Q Is it the typical case that pumping within

1 an alluvial aquifer will have a more direct impact on
2 the river system than pumping in a tributary aquifer,
3 say?

4 A What do you mean by "a tributary aquifer"?

5 Q An aquifer that is not directly
6 hydrologically connected to the alluvial zone.

7 A And what do you mean by "not directly
8 connected"?

9 Q There's no direct hydrologic connection.

10 A Is there indirect connection?

11 Q No.

12 A So it's not connected?

13 Q No.

14 A Well, if it's not connected, then obviously
15 it can't impact the river.

16 Q You spoke of an issue that I want to return
17 to, conservation of mass.

18 Could you explain to me the concept of
19 conservation of mass?

20 A Yeah. It's basically a simple principle.
21 It looks at a -- I'd call it a control volume, for lack
22 of a better term, and it says something like that the
23 inputs to that control volume minus the outputs from
24 that control volume have to equal a change in the mass
25 inside the control volume. That mass is neither created

27

1 nor destroyed in the process.

2 Q Why is that an important foundation for --

3 VOICE ON SPEAKERPHONE: Chris Beightel has
4 joined the conference.

5 THE COURT REPORTER: I'm sorry, could you
6 repeat the question?

7 Q (BY MR. WILMOTH) Why is that an important
8 foundation for a groundwater model?

9 A Well, that's one of the fundamental
10 building blocks of the groundwater model because it's
11 saying that we have to account for all the water.

12 Q Does the RRCA Groundwater Model account for
13 all the water, in your view?

14 A Yes, it does.

15 Q So it observes this principle of
16 conservation of mass?

17 A Yes, it does.

18 Q Does the observation of conservation of
19 mass translate through to the accounting procedures, in
20 your view?

21 A Yes.

22 Q So there's no unaccounted-for water in the
23 system at all?

24 A Well, it's mass balances in all the
25 different runs that are made.

1 Q Your CV indicates that you're a recognized
2 authority on numerical simulation models and their
3 application to groundwater problems.

4 Who has recognized you as such an
5 authority?

6 A I guess it would be generally my peers.

7 Q Any specific recognition you have received?

8 A Not that I can think of, no.

9 Q How do you know that they view you as an
10 authority in that regard?

11 A Just based on my experience interacting
12 with them over the years.

13 Q They've told you this?

14 A Yeah, people have.

15 Q Can you explain to me what a numerical
16 simulation model is and how it functions?

17 A The governing equations that we deal with
18 in groundwater models are partial differential
19 equations. And in order to solve those partial
20 differential equations with specific initial conditions
21 and boundary conditions, generally speaking, we can't --
22 well, let me back up.

23 In some circumstances, you can actually,
24 using calculus, come up with what are called closed-form
25 solutions to those equations for those conditions.

1 Those are referred to as analytical solutions.

2 But for many of the problems that we work
3 on, those kinds of analytical solutions can't be
4 obtained through calculus. And as a consequence,
5 numerical methods are used to solve those equations.

6 And they're solved through numerical
7 methods such as finite difference methods, finite
8 element methods, and those are what we refer to as
9 numerical methods.

10 Q And in your view, what are the advantages
11 of a numerical model versus an analytical process?

12 A Well, when you have a system that you're
13 trying to analyze that, say, has something less than
14 very simple geometries or simple variations in
15 conditions or parameters, there is no analytical
16 solution available.

17 And the numerical methods provide a
18 mechanism for solving those problems that you otherwise
19 wouldn't be able to solve, so that's one of the big
20 advantages.

21 Q Any other advantages?

22 A Well, generally speaking, it removes a lot
23 of the limitations that you would face in trying to
24 solve problems with analytical methods.

25 Q Are there any drawbacks to the numerical

1 modeling process?

2 A Well, in order to achieve these solutions,
3 you have to discretize the system you're dealing with
4 both in space and time, and that discretization
5 provides -- or leads to the potential for -- one are
6 called truncation error or things like that in the -- in
7 the finite difference equations that are used to make
8 the approximation, so there is some level of
9 approximation at that level of discretization.

10 Q Let me interrupt you there.

11 A Sometimes --

12 Q With respect to discretization, is that
13 what I might call isolation or isolating a problem,
14 you're making it discrete?

15 A No.

16 Q I'm not following the term
17 "discretization." Could you define that for me?

18 A Yeah. In terms of -- an analytical
19 solution, for example, provides an answer that's a
20 continuous function, let's say. I can pick out any time
21 or any location and using a formula, calculate some
22 result at that particular time and particular location.

23 With numerical models, the calculations are
24 made at specific locations and specific times that
25 are -- that are a discretization of the overall space or

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1 the overall time.

2 Q I'm sorry, I'm still not understanding the
3 term "discretization." Does that mean you're taking a
4 snapshot of the overall space and overall time?

5 A No.

6 Q Can you just try to define that term for
7 me, just that term, "discretization"?

8 A Well, discretization --

9 Q Or to discrate? Is that the verb?

10 A Discretization is the dividing-up of a
11 continuous function into discrete points.

12 Q Okay. So the -- it's a derivative of the
13 term "discrete"; is that right? How do you spell it?

14 A D-I-S-C-R-E-T-I-Z-A-T-I-O-N.

15 Q Okay. Is the RRCA Groundwater Model a
16 numerical model?

17 A Yes, it is.

18 Q Your CV indicates that these models can be
19 used to analyze a variety of groundwater problems. To
20 which problems are you referring in your CV?

21 A Well, as I go on to say in my CV, among the
22 ones that I've actually looked at are things like mass-
23 and heat-transport in groundwater systems, contaminant
24 migration --

25 Q These are the problems you're referring to?

1 A Yes -- saltwater intrusion, thermal energy
2 storage.

3 Q Does the RRCA Groundwater Model seek to
4 solve a problem or does it seek to do those things we
5 referred to earlier, defining impacts of groundwater
6 pumping and IWS credit, or do you view it as solving
7 some other problem?

8 A It helps in providing an answer to the
9 question, the question being -- the question could be
10 considered a problem you're trying to solve, and that's
11 to try to make estimates of the impacts of pumping on
12 streamflows and the effects of the import of water
13 supply credit in streamflows.

14 Q What does the development of a groundwater
15 model typically entail? What are the fundamental things
16 that are common to all such models?

17 A Well, it will obviously depend on the
18 circumstances. It would depend on the problem you're
19 trying to solve. And it may also depend on the amount
20 of information you have available to apply.

21 But as a general matter, typically what
22 happens is a domain or area of interest is identified.
23 And within that area, information is collected about the
24 hydrologic and hydrogeologic conditions. That
25 information is then used to develop a conceptual model

1 of how this groundwater system functions.

2 Then that conceptual model is -- is used to
3 develop a structure of the numerical model. And then,
4 depending on the availability of data and information,
5 usually a calibration process is undertaken to try to
6 help estimate the values of model parameters and
7 conditions that would be used to try to improve
8 preliminary estimates, say, of those parameters.

9 And then the model may be applied to make
10 specific calculations associated with the problem at
11 hand. And depending on the circumstances, sensitivity
12 tests may be conducted to try to evaluate the impacts of
13 alternate assumptions about model parameters or model
14 conditions.

15 So typically that's what goes into that
16 kind of process.

17 Q And if you're building a groundwater model
18 from the ground up, about how long does that typically
19 take you?

20 A I don't think there's any typical
21 timeframe. It all depends on the nature of the problem
22 and the scope of the information that you have to deal
23 with.

24 Q How -- strike that.

25 What's the shortest period of time in which

1 you've constructed a groundwater model from start to
2 finish?

3 A Oh, I think some models, I've probably
4 developed in a matter of days or a week.

5 Q How do those models compare to the RRCA
6 Groundwater Model?

7 A They wouldn't be of the scope or nature of
8 the RRCA Groundwater Model.

9 Q Have you ever developed a groundwater model
10 comparable to the scope or the nature of the RRCA
11 Groundwater Model in the same time period that you
12 developed, in association with others, of course, the
13 RRCA Groundwater Model?

14 THE DEPONENT: Could you read that back?

15 MR. WILMOTH: Would you read it back.

16 (The following question was read:

17 "Question: Have you ever developed a
18 groundwater model comparable to the scope or the nature
19 of the RRCA Groundwater Model in the same time period
20 that you developed, in association with others, of
21 course, the RRCA Groundwater Model?")

22 A Is the question, have I developed some
23 other model that took the same amount of time as the
24 RRCA Groundwater Model, is that --

25 Q (BY MR. WILMOTH) Let me try it this way.

1 How long did it take to develop the RRCA
2 Groundwater Model?

3 A Well, when we started on the -- I don't
4 even remember the date that we started on the process,
5 back in '99, 2000, whatever it was, and we completed it
6 whenever the report was issued.

7 Q So you commenced work on the groundwater
8 model as part of the groundwater model committee in
9 1999?

10 A In terms of my work, yes -- well --

11 Q When did the committee meet --

12 A I don't recall.

13 Q -- first? Was it in 1999?

14 A That, I don't recall. The earliest
15 meetings, it seems to me, were with the U.S. Geological
16 Survey because they were actually doing some development
17 work prior to our involvement. And I don't recall the
18 date off the top of my head.

19 But anyway, we utilized some of the
20 information that they had developed and work that they
21 had done as a beginning point for the work in the
22 groundwater committee.

23 Q And you don't recall when the model was
24 completed?

25 A Whenever the report was issued.

1 Q Was that 2003?

2 A I don't remember the date off the top of my
3 head.

4 Q So you don't know how long it took you to
5 develop the model?

6 A It took us several years.

7 Q How many?

8 A I don't recall.

9 Q How long did it take you to develop the H-I
10 Model?

11 A Well, the initial versions were developed
12 by Tim Durbin from our office at the time, and I don't
13 remember, offhand, how long it took him to get those
14 initial versions up and running.

15 Subsequently, when the -- when the team
16 that I participated with was called in, we spent, I
17 think, about six more months working on it at that time.

18 And there was also some work ongoing after
19 that from time to time, but I don't recall how long it
20 took Tim to get the model operating initially.

21 Q So you don't know how long it took to
22 develop the H-I Model?

23 A No, not in detail. No.

24 Q Okay. You did participate in developing
25 the RRCA Groundwater Model, though, correct?

1 A Yes.

2 Q So I'd like to walk through each of these
3 issues you've identified as -- in terms of elements of
4 developing a model.

5 How was the domain ID identified?

6 A Well, the U.S. Geological Survey had
7 already outlined the area. And generally speaking, they
8 went to the Platte River on the north and to the
9 boundaries of the basin over most of the rest of the
10 area, except off to the east, I think it was just sort
11 of truncated.

12 But they had already done that, and I think
13 that was basically just used from that point forward.

14 Q Do you recall any modifications having been
15 made to that domain?

16 A Not off the top of my head. There might
17 have been some on the east. I just don't remember.

18 Q The next thing I recall you mentioning was
19 the collection of information for the use in the model.
20 How was the information collected in the case of the
21 RRCA Groundwater Model?

22 A Well, each of the different parties, the
23 experts from the three states I think collectively tried
24 to work together to gather up information about pumping,
25 information about groundwater levels, information about

1 streamflows and the like.

2 So it was sort of a -- I think a collective
3 effort. The U.S. Geological Survey had already --
4 maintains a database for streamflows and has a database
5 for groundwater-level measurements, so those databases
6 were used.

7 Information was drawn from other sources,
8 other reports. Other modeling studies, I think, as well
9 had been done in parts of the basin, if I remember
10 right.

11 Q So as far as the nature of the information
12 collected, it was basically pumping, streamflow and
13 groundwater measurements?

14 A No, there was other information. There
15 were information about evapotranspiration. There
16 were -- there was information about precipitation.

17 There was information about stream
18 networks, for example, and elevations associated with
19 those stream networks. There were -- there was
20 information on reservoir levels.

21 There was lots of other sources of
22 information that were used.

23 Q In your professional judgment at the time,
24 did you consider there to be any gaps in the information
25 that you would have liked to have seen filled?

1 A Well, I think at the time, some of the
2 information was more plentiful than others. For
3 example, things like evapotranspiration, information
4 about that was more limited. There was assumptions made
5 about the nature of those areas over time and how they
6 may have changed.

7 Q Which areas are you referring to?

8 A The areas where groundwater
9 evapotranspiration could occur. And there were
10 discussions about that. There were -- I don't think
11 everybody realized that certain of the data were
12 probably better identified than others.

13 Q Did that become apparent at some later
14 date?

15 A Did what become apparent?

16 Q That some of the data were better
17 identified than others?

18 A No. I think that was just the nature of
19 the data that we had to work with.

20 Q Has any of that data been improved over
21 time?

22 A Well, certainly there's been more data
23 collected beyond the data that we had available to us.
24 So there is now more data than there was then. So in
25 that sense, there's improvement in the data because you

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1 have more of it.

2 Q Has that improved data been incorporated
3 into the model in any way?

4 A Well, certainly the data -- ongoing data is
5 incorporated, things like precipitation,
6 evapotranspiration, reservoir levels, that continues to
7 be incorporated.

8 Q What's the purpose of doing that?

9 A The purpose of doing that is because each
10 year we make an evaluation of the effects for that year,
11 and that data feeds into that process.

12 Q So in order to make those calculations, you
13 need up-to-date information?

14 A We utilize current information in that
15 process.

16 Q And if you didn't utilize current
17 information, you wouldn't have a very representative
18 result, would you?

19 A I don't understand the question.

20 Q If you used information for 2009 to
21 calculate impacts for 2010, it wouldn't be very
22 representative, would it?

23 A Well, it depends on what happened in 2010.
24 If it was the same as 2009, it may be representative.

25 Q Let's say precipitation was half in 2010.

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1 A What's the question?

2 Q If you used information based on events in
3 2009, including a precipitation value, to define what
4 happened in 2010, and that precipitation value changed,
5 was cut in half in 2010, the results of your 2009 run
6 wouldn't be very representative of what happened in
7 2010, would they?

8 A I'm still not following this question. Are
9 you saying that if I used precipitation values that
10 occurred in 2009 to simulate divisions in 2010, but the
11 real precipitation was half, would they be different?
12 Yeah, they would be different.

13 Q And they --

14 A The results would be different.

15 Q The results would be different.

16 And that run would not be representative of
17 what occurred in 2010, would it?

18 A What run?

19 Q The run that you conducted using the 2009
20 data.

21 A It would be different by some amount,
22 depending on how different the precipitation was in 2010
23 versus what it was in 2009.

24 Q Would it be representative of 2010?

25 A Well, "representative" is kind of an

1 ambiguous word. I mean -- I mean, would it be close?

2 Would it be -- I don't know. Depends on what the

3 numbers are.

4 Q Everything really depends on what the

5 numbers are, doesn't it? Whether something's

6 representative or not is entirely dependent on what

7 numbers are used, right? Is that what you're saying?

8 A Well, I'm trying to understand what you

9 mean by "representative."

10 Q I don't think it's an unambiguous term.

11 A I do.

12 Q If you wanted to represent actual impacts

13 in 2010, why and under what conditions would you ever

14 use figures from a different year?

15 A Well, if I was trying to make estimates of

16 what happened in 2010, for example, and I didn't have

17 the rainfall data from 2009, maybe I'd -- or, I'm sorry,

18 2010, maybe I would use estimates from 2009. Depends on

19 what I'm trying to do.

20 Q Let's assume you have a full suite of data

21 for 2010; would you ever use the data from 2009 to

22 represent what occurred in 2010?

23 A I'm not sure I understand the question,

24 but --

25 Q Well, I could ask it --

1 A -- if the question is --

2 Q -- in different ways, if you'd like.

3 A Well, if the question is, if I had data for

4 2010, would I choose to use data from 2009 instead? No.

5 Q Why not?

6 A Because 2010 data is current.

7 Q And 2009 wouldn't be very representative of

8 2010 then, would it?

9 A I have no idea if it would or would not

10 based on your question.

11 Q Would the 2010 data be more representative

12 of 2010 than 2009 data?

13 A I would think so.

14 Q Thank you.

15 In your experience as a modeler and working

16 with clients who rely on model outputs, would you

17 continue to employ a model on behalf of those clients

18 that failed to accomplish its purported purpose?

19 A Are you saying, if I knew the model was

20 giving the wrong answer, would I continue to use it? Is

21 that what you're asking?

22 Q That's what I'm asking.

23 A No.

24 Q Have you ever employed groundwater models

25 to simulate contamination plumes?

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1 A Yes.

2 Q And typically in those models, do they show
3 contamination moving upgradient or downgradient in the
4 aquifer?

5 A I'm not sure what you're typically
6 referring to specifically, but in a -- in a
7 contaminant-transport model, there are diffusion and
8 dispersion processes, some of which may occur in an
9 upstream direction in the groundwater flow and some
10 which occur in a downstream direction, some that occur
11 in a lateral direction.

12 Q When do they typically occur in a
13 downstream direction? And I should clarify. I think I
14 mean downgradient, but I don't mean in a stream
15 necessarily; I mean in an aquifer.

16 Under what conditions would they typically
17 occur in downgradient fashion?

18 A Well, dispersion is a process that's driven
19 by concentration gradients. Are you talking about
20 concentration gradients? Are you talking about
21 groundwater flow gradients? What are you talking about?

22 Q Groundwater flow gradient.

23 A Well, there will be a component of
24 dispersion along the direction of groundwater flow.

25 Q And if the groundwater flow gradient is

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1 typically in a downward direction, what does that tell
2 you?

3 A That the water is going down.

4 Q And if the model employs this groundwater
5 gradient, groundwater flow gradient in a downward
6 direction, but tells you the water is going up, what
7 does that tell you about the model output?

8 A I don't understand that question at all.

9 Q If the -- if you're employing a groundwater
10 model and you're utilizing -- you have a groundwater
11 flow gradient that is in a downward direction --

12 A So the groundwater is moving downward.

13 Q Yes. But you're employing a model and that
14 model simulates the water as moving upward, what does
15 that tell you?

16 A So let me see if I understand this
17 question. You're saying if via some independent
18 information I know the groundwater is moving down, but I
19 have a model that's saying it's moving up?

20 Q Yes.

21 A Then the model says it's going in the wrong
22 direction.

23 Q So what would you do in that case with
24 regard to the model and the data you have?

25 A I don't know. It would depend on all the

46

1 other circumstances surrounding why it was making that
2 prediction.

3 Q Would you attempt to investigate why that
4 was happening?

5 A I don't know if I would or wouldn't. It
6 would depend on whether it was influencing the problem I
7 was trying to solve or not.

8 Q Assume it was.

9 A Well, then I would make some investigation.

10 Q Would you attempt to reconcile that
11 seemingly illogical result?

12 A Depends on what the question is I'm being
13 asked to answer.

14 Q Well, let's assume you're being asked to
15 answer which direction the water is moving.

16 A Well, if I knew it was moving down, I've
17 already answered the question.

18 Q So the model is irrelevant?

19 A Well, if that's the question, the model is
20 irrelevant.

21 Q Do you typically adjust or recalibrate your
22 models when you employ them?

23 A Sometimes.

24 Q On what conditions do you typically do
25 that?

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1 A Well, in terms of typicality, I'm not sure
2 it's something that we do all the time.

3 But under some circumstances, I could
4 envision where additional data becomes available perhaps
5 that you didn't have during the first go-around, and you
6 decided that you wanted to incorporate that data into
7 the analysis, that would be a situation where you would
8 try to use that data and reevaluate the conditions with
9 that new data.

10 Q And what's the general purpose of that
11 recalibration process?

12 A Well, I guess it would depend on the
13 question being asked. But generally, it's to see if any
14 of the model parameters or conditions need some
15 adjustment as a consequence of new information.

16 Q Is that so that the model can better
17 perform its function of replicating whatever you want to
18 produce?

19 A That could be one reason.

20 Q So getting back to the development of the
21 RRCA Groundwater Model, after the domain identification
22 and the collection of information, you said that you
23 would work to develop some kind of a conceptual model.

24 Can you explain that process and how it
25 evolved in the context of the RRCA Groundwater Model?

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1 A Well, I think a lot of that work had been
2 done, to a large extent, already by the USGS when we
3 started our work. In fact, they had already taken it to
4 the next level of actually putting together the
5 structure of a numerical model.

6 Q Did that have a name at that time, the
7 model that they were working on?

8 A You know, I don't remember. I do remember
9 going to some presentations where they described what
10 they had accomplished and what they were working on, but
11 I don't recall if they had a -- I don't recall if they
12 had a name for it or not.

13 Q So you started with that USGS base model,
14 and that had been taken to what you call the next level.
15 Then what happened?

16 A Well, as Dr. Wilson said yesterday, that
17 was a long time ago; but my recollection is that we
18 began the process of trying to calibrate the model.

19 Q And how was the model calibrated?

20 A I think -- I think the -- I'm trying to
21 remember if the USGS had done some work in that regard.
22 I'm not -- my best recollection is that they had made
23 some initial runs and were perhaps having some
24 difficulties. I can't remember specifically, but --
25 then I'm sorry. Can you repeat the question?

1 Q Sure.

2 How was the model -- the RRCA Groundwater
3 Model calibrated?

4 A The process that we went through basically
5 was to first develop some information that would be used
6 as the basis for the calibration. That was mainly
7 looking at groundwater levels, changes in groundwater
8 levels, and stream base flow estimates and changes in
9 those stream base flow estimates. So that information
10 was gathered and evaluated, and that took some effort.

11 And then that was used as the basis for
12 judging the calibration process, for using -- it was
13 used as the basis for making adjustments during the
14 calibration process.

15 Q And the -- if I understood you earlier, the
16 calibration process is done to estimate parameters and
17 to improve preliminary estimates of certain values; is
18 that right?

19 A It's used to adjust model parameters, model
20 conditions.

21 Q Do you recall any specific parameters or
22 conditions that were adjusted as a result of the
23 calibration process for the RRCA Groundwater Model?

24 A Well, we certainly looked at distributions
25 of hydraulic conductivity, for example. We looked at

1 issues related to the assignment of conditions along the
2 stream network.

3 We looked at conditions related to the
4 amounts of recharge to the groundwater system for
5 precipitation. We looked at issues related to
6 differences in recharge between different soil types
7 throughout the area. We ultimately looked at
8 differences in recharge between irrigated land and
9 nonirrigated land.

10 All of those things were probably
11 considered in one way or another through the calibration
12 process or as part of the calibration process.

13 Q And did that process improve your
14 preliminary estimates?

15 A I think it did, yes.

16 Q Did you conduct any sensitivity analyses?

17 A I don't recall that we conducted any formal
18 sensitivity analyses, but I know just by virtue of the
19 process that we went through that we were basically
20 conducting sensitivity analyses kind of all the time in
21 looking at what the impact would be of different
22 adjustments in model parameters in the sense that's
23 basically a sensitivity calculation.

24 Q And then finally, I've got a reference to
25 the process of updating models.

1 Have you been a part of any updates to the
2 RRCA Groundwater Model since it was completed in, I
3 believe it was '03?

4 A I seem to vaguely recall some adjustments,
5 but it may have been to just points of calculation that
6 were done after that along the stream network, maybe a
7 couple times. I don't remember any other parameter
8 adjustments off the top of my head.

9 Q Do you recall the reason for those updates?

10 A I think it had to do with where specific
11 calculations were being made with regard to the stream
12 network system and some adjustments in those locations
13 were made.

14 Q Was there a reason for that, though? I
15 understand that's what was done, but was there a reason?

16 A I'm sure there was at the time. I don't
17 remember what it was off the top of my head.

18 Q Have you had occasion to update the H-I
19 Model since it was completed?

20 A I haven't personally, no.

21 Q Do you know whether it's ever been updated?

22 A By "update," you mean beyond the use of the
23 model on a --

24 Q Yes.

25 A -- annual basis, in terms of changing

1 conditions in the model?

2 Q Yes.

3 A That, I don't know. I don't know.

4 Q Do you still use the H-I Model?

5 A Do I?

6 Q Yes.

7 A No.

8 Q Do you know whether it's still in use in

9 the Arkansas River Basin?

10 A Yes, I believe it is.

11 Q Your CV notes that you're on the forefront

12 of combining models with linear programming techniques

13 to optimize groundwater supplies.

14 Could you explain what that means?

15 A That means trying to incorporate certain

16 kinds of optimization analyses with a groundwater model

17 so that you can try to determine where you should pump

18 and how much you should pump, for example, to achieve

19 certain end points, say, in maximizing recovery of

20 groundwater without producing a certain water-level

21 decline. That might be one instance.

22 Another instance might be trying to -- in

23 looking at contaminant recovery, for example, trying to

24 figure out where to place wells and how much to pump in

25 order to achieve -- to maximize, say, recovery or to

1 achieve control over the groundwater contamination.

2 So it's combining those two methodologies,

3 both the model and the linear programming, in

4 optimization studies.

5 Q Does that optimization process or your

6 experience have any bearing on surface water supplies?

7 A Not that I know of, no.

8 Q Have you ever utilized this optimization

9 process to minimize the impact of groundwater pumping on

10 the stream?

11 A No.

12 Q Would that be an appropriate use of that

13 optimization concept?

14 A That's something you could probably do

15 through that process, or you could try to do that, I

16 think.

17 Q So, for example, if we wanted to determine

18 which wells in a basin to shut down or how many to shut

19 down, we could utilize this optimization concept in that

20 process if we wanted to maximize streamflow?

21 A It's possible.

22 Q And what would be the benefit of doing

23 that?

24 A I don't know that -- the answer to that

25 question. I would have to understand what problem

1 you're trying to solve. If your goal is to try to
2 maximize streamflow, the benefit would be maybe you
3 could come up with a better way to maximize streamflow,
4 I guess.

5 Q What if you wanted to maximize streamflow
6 with a minimum impact on groundwater pumping? In other
7 words, you're trying to balance streamflow maximization
8 with impacts on groundwater users?

9 A It's possible you might be able to do
10 something along those lines.

11 Q Did you employ any of the optimization
12 concepts in either of your expert reports?

13 A For this matter?

14 Q Yes.

15 A No.

16 Q Is there a reason you elected not to do
17 that?

18 A Well, in order to reach the conclusions
19 that I reached and to address the questions that I was
20 trying to address, I didn't.

21 Q What conclusions were you trying to reach
22 and what questions were you trying to address?

23 A Well, they are described in my report -- or
24 in my reports as to what specific questions we were
25 addressing, but basically looking at overall trends in

1 groundwater CBCU over time and how that might change,
2 depending on changes in the pumping regimes that might
3 be considered going forward into the future.

4 Q Who instructed you to prepare your reports?

5 A I don't recall a specific instruction, but
6 I guess it would have probably come from the attorneys
7 saying that I had to submit an expert report as part of
8 my work.

9 Q Join the club. My sympathies. There's a
10 lot of people that are blaming us for that.

11 MR. WILMOTH: Why don't we take a
12 ten-minute break.

13 (Recess taken from 9:29 a.m. until
14 9:42 a.m.)

15 Q (BY MR. WILMOTH) Mr. Larson, I'd like to
16 turn to your -- what I call your first report, which is
17 marked KS 672. We'll mark this as Exhibit 4.

18 (Deposition Exhibit 4 was marked.)

19 MR. DRAPER: Exhibit 4?

20 THE COURT REPORTER: Yes.

21 MR. WILMOTH: Yes.

22 Q (BY MR. WILMOTH) Mr. Larson, could you
23 identify this document for me, please.

24 A Yes. This is a report prepared by
25 Mr. Perkins and myself.

1 MR. DRAPER: Is the mute off?

2 MR. WILMOTH: Oh, no, sorry.

3 MR. DRAPER: Can you guys on the phone hear
4 us? Okay. We just took the mute off. We realized we
5 hadn't. We're just beginning to resume the deposition.

6 A So this is the report prepared by
7 Mr. Perkins and myself regarding impacts from 2005 and
8 2006.

9 Q (BY MR. WILMOTH) And as I understand it,
10 the purpose of this report is to compute the impacts of
11 a remedy scenario; is that right?

12 A That's correct.

13 Q Who asked you to perform this analysis?

14 A I don't recall specifically. It was
15 probably the outcome of a discussion among our team
16 about what kind of calculations needed to be made.

17 Q And what were your specific instructions
18 with regard to performing this particular calculation?

19 A We basically wanted to determine if pumping
20 was removed from this -- what we call -- what's called
21 the 10 percent two-year response corridor for the years
22 2005 and 2006, how that would have changed the
23 calculations of the RRCA Groundwater Model under those
24 circumstances.

25 Q And were you instructed to do that, or did

1 you exercise discretion in developing this objective?

2 A As I testified earlier, I don't recall
3 specifically how the need for this run came about; but
4 it had to do with interacting with Mr. Book and others
5 on the team as to what kinds of calculations they needed
6 to make some of their analyses.

7 Q So Mr. Book told you, I need X calculation,
8 and you just performed the calculation?

9 A I don't think it was quite that simple, but
10 as a consequence of those discussions, the need for this
11 calculation emerged, and then Mr. Perkins and I made the
12 calculations.

13 Q So if I were trying to determine the
14 genesis of this decision and how you arrived at
15 selecting this area, would I speak to you about that or
16 Mr. Book?

17 A Probably Mr. Book or Mr. Barfield.

18 Q So Mr. Barfield was involved in this
19 selection also?

20 A Well, like -- like I said, my recollection
21 is that I didn't recall a specific request to make this
22 specific calculation, but it came up in the context of
23 discussions we were having about the different reports
24 that were being prepared, and then there was a need to
25 make this calculation.

1 Q Do you recall what your input was in that
2 decision?

3 A Not specifically, other than we could apply
4 the model to make those calculations.

5 Q That S.S. Papadopoulos could apply the
6 model?

7 A Mr. Perkins and I together could apply the
8 model.

9 Q Okay. So it sounds like, then, there was a
10 need that someone identified, and you-all just ran the
11 model?

12 A I think, in this particular instance,
13 that's probably fair.

14 Q Okay. I have a couple of questions in this
15 line, but if these are deferred properly to Mr. Book,
16 feel free to say -- suggest that.

17 Do you recall why you ultimately were asked
18 to apply this 10-2 shutdown area?

19 A Well, as I recall, the question was, if
20 some actions had been taken in 2005 or 2006 to reduce
21 pumping, what could have been accomplished if pumping
22 had been reduced?

23 And then discussions were about, you know,
24 where would be the best places to reduce pumping if we
25 wanted to evaluate that question. And the

1 10-percent/2-year response corridor seemed to be the,
2 you know, best place to look for sort of maximizing that
3 short-term effect of pumping reduction. And that just
4 kind of came out in the discussion.

5 Q When you say the "short-term effect," are
6 you referring to the effect on river flows?

7 A That's correct.

8 Q Did you consider any other actions? I
9 think was the term you used, that this was one action
10 that you evaluated. Did you consider any other actions
11 that might have been taken?

12 A I'm sure there were discussions about those
13 in the process, but my best recollection was just --
14 with respect to my involvement was issues over, okay, if
15 you wanted to reduce these effects in the short term,
16 how would you go about it?

17 Q Did you consider any alternatives involving
18 surface water curtailment?

19 A I didn't, no.

20 Q So the scope of your considerations were
21 limited to different groundwater curtailment scenarios;
22 is that right?

23 A Yes, I think that's fair.

24 Q Do you recall if that was an election made
25 by Mr. Book or Mr. Barfield?

1 A No, I don't.

2 Q Now, if I understand your report, you
3 assumed all other conditions in the model were the
4 historical conditions of '05 and '06; is that correct?

5 A That's correct.

6 Q Why did you choose to elect those
7 conditions?

8 A Because the question that we were being
9 asked to address was, what would have happened in 2005
10 and 2006 if pumping had been reduced.

11 Q So is it fair to say that you were trying
12 to isolate the effect of that potential reduction if it
13 were applied in those years?

14 A We were trying to determine if the pumping
15 within this 10-percent/2-year corridor had not occurred
16 in 2005 and 2006, how would those results have been
17 different from --

18 Q All other things being equal?

19 A All other things being equal.

20 Q Okay. Have you had any occasion to review
21 the Integrated Management Plans that are presently in
22 place in the State of Nebraska? And by this, I mean the
23 third-generation plans, if you will.

24 A Yes. To some extent, yes, I have.

25 Q Is that 10-2 concept reflected in those

1 plans?

2 A As I recall, yes.

3 Q Are there other management actions that are
4 contained in those plans?

5 A There's discussions, I think, as I recall
6 of potentially other things.

7 Q And how is the 10-2 region shut down in
8 your understanding under those IMPs? Under what
9 conditions would that occur?

10 A My understanding is that if there's
11 determined to be some necessity of curtailment of use or
12 the replacement of impacts determined through their
13 process, that one of the alternatives that could be
14 employed is to reduce or eliminate pumping within that
15 corridor.

16 Q And there are other alternatives that could
17 be employed; is that correct?

18 A Well, my understanding of the plans is that
19 there are discussions of other possibilities, but there
20 are no real specifics as to what those were. And this
21 was just among what could happen if those other
22 possibilities, once they were fleshed out, would not be
23 sufficient to produce the level of curtailment that was
24 believed to be necessary.

25 Q So is it your understanding that the IMPs

1 prioritize groundwater curtailment as the principal
2 action first that would be taken and then followed by
3 other alternatives or supplemental activities?

4 A My recollection was, it was kind of the
5 other way around, that -- that if the -- if there was a
6 need to make up for depletions that were beyond some
7 threshold, that initially plans could be developed by
8 NRDs or whoever to see if they could make it up in some
9 other way first.

10 And then depending on the circumstances of
11 those determinations, they might go to this level of
12 curtailment to actually impose pumping restrictions
13 within these areas.

14 That's kind of my understanding.

15 Q Okay. But this report doesn't attempt to
16 capture any of those alternatives, right?

17 A No. This report attempts to estimate the
18 effect of what would have occurred in 2005 or 2006 if
19 pumping in the 10-percent/2-year corridor was removed.

20 Q Okay. I'd like to turn to your -- what I
21 call your second report, which we'll mark as Exhibit 5.
22 This begins at KS 679.

23 (Deposition Exhibit 5 was marked.)

24 Q (BY MR. WILMOTH) And I just ask if you
25 could identify that document for me.

1 A Yes. This was the report that we
2 submitted. It's without the addenda or the changes that
3 we talked about earlier today.

4 Q Certainly. And for the record, those
5 changes are Exhibit 2.

6 I'd like to ask you the same questions I
7 asked you about your prior report. Who directed you to
8 prepare this analysis?

9 A Well, again, my answer is going to be
10 similar, that as a result of discussions with the team,
11 it was determined that we wanted to make estimates of
12 potential future trends in the groundwater CBCU for
13 Nebraska under different conditions going forward in the
14 future.

15 So that was the initial impetus of it, and
16 then other parts of the report were based on having done
17 some of those calculations and looking at calculations
18 by others to incorporate some of those other analyses as
19 well.

20 Q Was this information generated to answer a
21 question posed by Mr. Book?

22 A Well, in part, the work was prepared to
23 provide information to feed into some of his analyses.
24 I don't know that it was specifically him that made the
25 request or I don't think there was a specific request.

1 It was just the result of discussions over what kinds of
2 materials would be presented.

3 Q Do you remember what your specific input
4 was in regard to making the choices concerning the
5 scenarios played out in this report?

6 A Well, we had to -- in order to look down
7 the road, so to speak, we had to come up with a
8 scenario, first of all, in terms of hydrologic
9 conditions that might occur in the future, and I
10 certainly participated in that.

11 We had to make estimates of how we thought
12 pumping might occur in the future based on our
13 understanding, say, of the IMPs and those kinds of
14 things. And so collectively, we did that.

15 Then I looked at some of the analyses that
16 had already been done by some of the Nebraska experts
17 related to -- and experts and others related to
18 addressing these kind of future conditions, and I
19 decided that using some of that information was also
20 helpful in terms of looking at these trends going
21 forward.

22 Q Were you given any limiting instructions in
23 terms of what you should and should not evaluate?

24 A Not that I can recall, no.

25 Q Were you instructed to evaluate only the

1 impact of groundwater curtailment?

2 A I don't recall such an instruction, no.

3 Q So who would you say was the individual
4 responsible for making the decision about the various
5 hydrologic scenarios that you project into the future?

6 A Well, I don't think there's any one person.
7 I think it was sort of a -- based on collective
8 discussions among the group, it was decided that there
9 was -- this was a reasonable way to go to make these
10 kinds of evaluations.

11 And then I would have independently
12 incorporated and evaluated some of the other evaluations
13 that had been done by Nebraska to be sure that what we
14 were using was reasonable and useful.

15 Q So you were a part of that process of
16 developing this climatological or hydrologic scenario?

17 A Yes.

18 Q And were you a part of the process of
19 developing the appropriate pumping projections, for
20 example?

21 A Yes.

22 Q As I understand it, your report is part of
23 an effort to, I think, as you say it, evaluate what
24 level of pumping reduction in Nebraska would be required
25 so that Nebraska would be in a position to maintain

1 Compact compliance when dry periods recur in the future,
2 at least over the next several decades.

3 Why does Nebraska have to limit its
4 groundwater pumping to comply with the Compact?

5 A Well, it's my understanding that under
6 the law of the Compact, they're required to comply with
7 the Compact.

8 And this analysis tries to get at what
9 would be necessary to be in compliance, what might be
10 necessary to be in compliance, looking out into the
11 future, especially when these dry periods recur because
12 they tend to be the more critical periods in terms of
13 Compact compliance.

14 Q And what was your test for compliance in
15 your future projections?

16 A That was part of the work that Mr. Book
17 undertook based on some of the results from our modeling
18 calculations. He would integrate that and make those
19 determinations.

20 Q So you didn't apply the results of your
21 work to the accounting procedures and make a compliance
22 determination; is that right?

23 A Well, Mr. Book looked into those compliance
24 issues as part of his work.

25 Q Okay. I'll speak with Mr. Book about that.

1 What role does surface water play in
2 Compact compliance?

3 A Well, surface water is among one of the --
4 is -- as far as I know, is one of the components that's
5 considered from the standpoint of determining amounts of
6 water in the stream, determining amounts of surface
7 water consumed in the irrigation. All those things
8 factor into the calculation, as I understand it.

9 Q And is there a role for augmentation
10 projects in terms of Compact compliance?

11 A The FSS, I believe, speaks to augmentation.

12 Q Does your analysis factor in surface water
13 use reductions or augmentation projects?

14 A In this report? No.

15 Q In this report.

16 (A pause occurred in the proceedings.)

17 Q I'm sorry. I didn't hear the answer.

18 A I didn't -- oh, I'm sorry, I didn't realize
19 there was a question.

20 MR. WILMOTH: Can you read that back.

21 (The following answer was read:

22 "Answer: In this report? No.")

23 Q (BY MR. WILMOTH) Oh, I'm sorry, so the
24 answer is no, the report doesn't factor in --

25 A In this report, no, we don't get into that

1 issue.

2 Q Thank you.

3 Now, you mentioned the anticipation of
4 certain dry periods in the future. Can you tell me what
5 dry periods you're referring to?

6 A Well, these are periods, obviously, when
7 the precipitation is low and the amount of groundwater
8 recharge and surface water runoff and other things would
9 generally be low. So these are periods when --
10 generally, when precipitation is low.

11 Q Is there a block of time that you believe
12 represents the dry period? Maybe a historical period?

13 A We didn't try to break out a specific
14 period. I mean, obviously some years are drier than
15 others. You can look at the precipitation data or the
16 recharge data and see which years those are.

17 Q So there's no particular dry period that
18 you're trying to address in your analysis, no defined
19 dry period?

20 A Well, in the analysis that we conducted, we
21 used the period from 1995 to 2009 as sort of our
22 surrogate going forward, and we simply repeated that
23 cycle four times.

24 And during that cycle, there are drier
25 periods. I think 2002 is probably one of the drier

1 periods in that cycle.

2 Q So as far as dry periods go, at least in
3 that cycle, you're referring to historical periods that
4 were experienced that you think will be experienced in
5 the future?

6 A That could be, yes.

7 Q Okay. Do you know when those dry periods
8 will occur in the future?

9 A No.

10 Q Now, I mentioned that we're presently on
11 the third-generation IMPs earlier. Do you know when the
12 first-generation IMPs were adopted?

13 A Not off the top of my head, no.

14 Q If I suggested early 2000s, would that
15 sound reasonable?

16 A I'd have no way of telling you yes or no.

17 Q Well, if we're on our third-generation
18 IMPs, do you think it's possible that there might be a
19 fourth-generation IMP in the next 60 years?

20 A I suppose anything's possible.

21 Q Does your present analysis account for any
22 such revision?

23 A A fourth generation?

24 Q Yes.

25 A That might occur in the future?

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1 Q Yes.

2 A No, I don't think so, although we did try
3 to do some sensitivity studies to look at how things may
4 change going in the future. Perhaps some of those
5 things might be among the considerations there.

6 Q Again turning to your statement about dry
7 periods that might occur several decades from now, on
8 the ability of Nebraska to maintain compliance, at least
9 at that time, based on your analyses, do you believe
10 there is a threat of noncompliance in the immediate
11 future?

12 A My sense is that there's always a threat of
13 noncompliance from the standpoint that we don't know
14 when these dry periods might occur or how severe they're
15 going to be.

16 And then it also depends on what kinds of
17 conditions have been occurring prior to that, as to what
18 level of impact you may have during that dry period.

19 Q So if the prior five years were wet, say,
20 that might mean something different for the likelihood
21 of noncompliance than if the prior five years were dry;
22 is that what you're saying?

23 A Or average or something like that.

24 Q Or average?

25 A Yes.

1 Q So, for example, if you took the last five
2 years, 2007 to 2012, and ran that out 12 times, how
3 would the likelihood of noncompliance differ from what
4 your projections show?

5 A Well, I can only give you my sense based
6 on, you know, my general experience with running the
7 model. But I think those years, subject to checking,
8 would probably be -- or tend to be wet.

9 And my sense is that, as you continue to
10 incur wet periods going forward, the degree of
11 depletions tend to increase, such that when a dry period
12 recurs in that cycle, you would tend to be at a higher
13 level of depletion than you would be under other
14 circumstances.

15 Q Given your 60-year projection, do you know
16 along that 60-year time horizon when Nebraska will be
17 unable to comply with the Compact? Have you pinpointed
18 that time?

19 A No.

20 Q Do you have an opinion as to when these dry
21 periods will occur over that 60-year time period,
22 specifically what years they will occur in?

23 A No.

24 Q As I understand it, you used the model
25 to --

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1 A Maybe I -- are you saying, do I know when
2 the dry periods occurred in the cycles that I used, or
3 when they will occur --

4 Q When they will occur in the future.

5 A So when some dry period will occur? No, I
6 don't know, the answer to that is.

7 Q If I understand it, the model was used by
8 you-all to compute the effects of various levels of this
9 reduced pumping on groundwater consumptive use and the
10 imported water supply credit; is that right?

11 A Yes.

12 Q And I assume you're referring to the RRCA
13 groundwater model?

14 A Yes.

15 Q We spoke earlier of the function of the
16 model as identifying, in any given year, consumptive
17 uses and imported water supply credits.

18 Was the model designed to be a predictive
19 tool, in your view, or to just test compliance on an
20 annual basis?

21 A Well, the goal of the model originally and
22 for the purpose of the FSS was to provide the tool for
23 making the calculations and estimates for the impacts of
24 pumping and imported water supply.

25 Q On an annual basis?

1 A On an annual basis going forward.

2 Q When you conducted your analysis, did you
3 run the model just essentially as it exists with various
4 assumptions, or did you make any modifications to the
5 model itself?

6 A I believe we just used the model as it
7 was -- at least I don't remember any modifications we
8 might have made. We may have -- we may have modified,
9 at some point, the water budget output, just so we could
10 see the numbers with greater precision than we were
11 seeing before.

12 Q Do you have any recollection of what that
13 might have entailed?

14 A I -- yeah. And I don't even know if we
15 used that particular one here. But I do recall that I
16 made some changes to the output of MODFLOW so that when
17 it -- when it would revert over to scientific notation,
18 that I wouldn't lose the precision of the numbers in the
19 output that is printed by the program. So that was a
20 cosmetic thing.

21 Q Do you believe it had any material effect
22 on your conclusions?

23 A No, but it did help me when I would look at
24 outputs from the model to be able to compile those
25 outputs more readily.

1 Q Is there anyplace within the report or the
2 supporting materials that explain that modification if
3 we were to attempt to replicate it?

4 A I'm not sure if there is or not.

5 Q How did you go about selecting the various
6 pumping reduction scenarios that you evaluated in this
7 report?

8 A Well, one of them was the -- it was looking
9 at sort of a baseline at a level of pumping equal to
10 the -- 80 percent of the 1998-to-2002 average pumping as
11 it's described in the IMP, so that was --

12 Q Sure.

13 A -- that was one of them.

14 Q So the basis for your selection was the IMP
15 content?

16 A Yes, and --

17 Q Okay.

18 A -- and the requirement to maintain average
19 pumping at 80 percent of the 1998-to-2002 numbers, so
20 that formed the basis for one.

21 Then some of the alternatives were, we
22 looked at one with 75 percent rather than 80 percent.

23 Q Was that the sensitivity analysis you
24 referred to?

25 A That was part of the sensitivity study,

1 yes.

2 And then -- then we also, as described in
3 the report, looked at various levels of reduction within
4 certain geographic areas. And we did some experimenting
5 with that and then eventually, for the purpose of this
6 report, utilized a particular corridor area and looked
7 at various levels of reduction within that corridor.

8 Q Was that discussion or those selections
9 also a group activity or was that something that you
10 were primarily responsible for?

11 A Well, we were discussing how the model
12 results would feed into analyses that Mr. Book was
13 conducting, and I think I may have suggested that we
14 make different levels of production calculations to feed
15 into that.

16 Q If you pardon the pun, were you trying to
17 book in some scenarios for Mr. Book?

18 A Yeah, we were trying to get --

19 Q My apologies to Mr. Book.

20 A We were just trying to understand if we
21 reduced pumping by various levels, how much change that
22 would create so he could factor that into his analysis.

23 Q And then Mr. Book would select, for
24 purposes of his own analysis, what he felt was best?

25 A Well, based on his analysis, he came back

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1 with requests to us for some, actually, intermediate --

2 Q Okay.

3 A -- calculations.

4 Q And you evaluated the impact of these
5 various scenarios on the imported water supply credit,
6 right?

7 A That was also part of it, yes, I think.

8 Q How did you go about doing that? Did you
9 just apply the groundwater model?

10 A Yes. The groundwater model and the
11 accounting programs that are associated with the use of
12 the groundwater model.

13 Q What did your analysis show with regard to
14 the imported water supply credit over time?

15 A Well, the -- it depends on what scenario
16 you're talking about, obviously, but it's contained
17 within the tables that we have in the -- in the back of
18 our report in terms of what our projections were for
19 that credit going forward.

20 Q Did you find it generally increasing or
21 decreasing?

22 A Depends on the circumstances. Some bases
23 it increased. Looks like generally, I would say,
24 increasing, but not always.

25 Q Would you expect that result, given your

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1 experience with the model?

2 A To some degree, but it obviously depends on
3 the circumstances.

4 Q Would you have been surprised if it showed
5 a decrease?

6 A Not necessarily.

7 Q Now, getting back to your 60-year
8 projection, as I understand it, you essentially cycled
9 the years '95 to 2009 four times into the future; is
10 that right?

11 A Yes, that's right.

12 Q Do you have an opinion as to the
13 probability of that cycle occurring over the next 60
14 years?

15 A Not directly, but the one thing that we did
16 investigate that I've described in the report is we
17 looked at some runs that Nebraska had conducted testing
18 a whole variety of different potential future scenarios
19 to kind of see where our scenario fell with regard to
20 that. And it looked to be about the 60th percentile, is
21 my recollection.

22 Anyway, that was my recollection, it was
23 somewhere in the 55-to-60th percentile of the -- other
24 results were comparable.

25 Q These are the Nebraska runs you refer to in

1 your report?

2 A Yes.

3 Q In what context were those runs performed?

4 A I'm not exactly sure what context they were
5 performed in. They looked to me to be an attempt to
6 evaluate statistically, in a sense, the potential
7 outcomes that you might have, depending on whatever the
8 cycle of climate might be. And so random cycles of
9 climate were used to generate a whole ensemble of
10 outputs.

11 Q How would you typically employ that
12 information as a modeler?

13 A Well, the way I used it was to look at the
14 frequency with which, not only the kinds of trends that
15 you would get in the groundwater CBCU, but to also
16 evaluate during those cycles when drier years came
17 along, what the level of groundwater CBCU was during
18 those drier years as a means of comparing against the
19 surrogate that we selected, the three cycle -- or the
20 four cycles of 2000 -- or 1995 to 2009 to see how we
21 fell within those.

22 Q And I understand that's how you used it in
23 this report, but how would you normally use a series of
24 randomized runs like that? What's the function of those
25 kinds of runs?

1 A Well, they give you sort of a statistical
2 distribution of potential outcomes, and that's typically
3 how they're used is to come up with a statistical
4 distribution of potential outcomes.

5 Q But you don't know what Nebraska was
6 attempting to achieve through those runs or what -- the
7 context in which they were performed; is that right?
8 How did you come about them?

9 A We were looking through the materials that
10 Nebraska produced to us, and they were in there. And I
11 looked them over and decided that they could be helpful
12 to me in evaluating the work that I had done.

13 Q Were these contained on the terabyte hard
14 drive that was provided early on in this litigation?

15 A Yes, I believe so.

16 Q How did you go about distinguishing those
17 materials or those runs from any of the other material
18 on the hard drive?

19 A I'm not sure I understand the question.

20 Q Why did you believe that that was any more
21 or less helpful than anything else on the hard drive?

22 A I don't think I looked at it from that
23 point of view. I looked at it that this particular set
24 of runs could be helpful to me in evaluating our work.
25 There were other things on there that were also helpful.

1 Q So there were other runs besides these on
2 the hard drive?

3 A Yeah.

4 Q Any idea how many?

5 A No. I haven't sat down and tried to
6 calculate that.

7 Q So you haven't looked at all of those, I
8 assume?

9 A Well, we've looked through the hard drive
10 as much as we could. I think the answer that I gave you
11 was, I didn't use everything that was in there. I
12 didn't try to count how many different runs were in
13 there.

14 Q You've examined every run that we provided,
15 though?

16 A Well, I've certainly looked through that
17 hard drive a fair amount to try to understand what all
18 was in there.

19 Q Have you examined every run that was
20 provided?

21 A I don't think we've examined every run.

22 Q As a professional modeler, do you typically
23 conduct a range of model runs to determine the best way
24 to accomplish your given objective?

25 A You might.

1 Q In fact, isn't that what you did in this
2 very report?

3 A We made model runs with different
4 assumptions about what conditions would be going
5 forward. If that's what you're referring to as a range
6 of model runs, then yeah, that's what we did.

7 Q Among the runs that you identified in your
8 report conducted by Nebraska was a run conducted by
9 Nebraska in 2006. Are you familiar with that run?

10 A I believe it was actually a series of runs.

11 Q And I infer from your report that you
12 believe that those runs compare favorably to your
13 analysis; is that right?

14 A Well, when I looked at the results of those
15 runs, it's used -- utilized different assumptions going
16 forward in terms of cycling climate, for example, so
17 that the results seemed comparable and consistent with
18 the results that we were getting using our scenario.

19 Q And what do you take from that
20 comparability?

21 A Well, one of the things that I concluded
22 from it, as described in my report, is that the trends
23 that you see in things like groundwater CBCU, for
24 example, are highly correlated to the amount of pumping,
25 which is not particularly surprising, but -- and that

1 you can look at various levels of pumping and ascertain
2 what kinds of trends you might expect to have under
3 certain circumstances.

4 Those trends will vary somewhat based on
5 whether the climate over that period is wetter or drier,
6 but there is a strong correlation between -- for a given
7 sequence between the amount of pumping and the trend.

8 MR. WILMOTH: Let's take five minutes, if
9 we can.

10 (Recess taken from 10:29 a.m. until
11 10:40 a.m.)

12 Q (BY MR. WILMOTH) Mr. Larson, before we
13 broke, we were discussing the series of runs from 2006
14 that Nebraska conducted.

15 Can you tell me your understanding of how
16 the Integrated Management Plans in place today differ
17 from those in place in 2006?

18 A Well, my understanding is that the current
19 ones incorporated an attempt to try to estimate what
20 kinds of conditions might be going to occur in the
21 following year.

22 Then based on the results of those
23 calculations and evaluations, certain decisions are made
24 about whether or not they will -- are likely to be in
25 compliance or not compliance.

1 And then based on that determination, it
2 sort of triggers a series of potential actions, assuming
3 a shortfall, for example. I think in that -- in that
4 way, they're different.

5 Q So can you explain to me why you feel that
6 those runs from 2006 are relevant and useful to your
7 analysis today?

8 A The runs in 2006 are very useful from the
9 standpoint that they provide information that shows how
10 varying levels of pumping influence the trends in
11 groundwater CBCU over time going out significantly into
12 the future. In this case, I think it was two cycles of
13 20 years, so 40 years in the future.

14 And that we were able to use those runs to
15 look at that relationship and then also to compare that
16 relationship to the results that we got using our
17 sequence of runs to see kind of where we stood in terms
18 of the overall impacts of pumping going forward.

19 Q So if I understand, it's really the
20 reductions of the groundwater pumping in various ways
21 that you're looking at, not the IMP provisions? Is that
22 what you were taking as the relevant component of those
23 2006 runs?

24 A Yeah. The 2006 runs -- although there was
25 a whole series of runs with different scenarios -- but

1 the part that I was interested in was if I looked at the
2 overall level of pumping and how that influenced the
3 trends in groundwater CBCU at different levels of
4 overall pumping and what that relationship looked like;
5 and then comparing that result to -- or that
6 relationship to the results that we obtained.

7 And also do some more recent evaluations, I
8 think -- well, when you look at that trend, you look
9 at -- at what point they estimate -- when you look at
10 that relationship and looked at what that relationship
11 would suggest the level of pumping needed to be to make
12 the overall trend approximately zero, that number seemed
13 to compare with some values that were reported in some
14 of the documents that Nebraska had made in relation to
15 evaluating options for the Integrated Management Plans.
16 So in that way, it was also instructive.

17 Q Okay. I know I'm jumping ahead a bit in
18 your report. But is this what you're referring to in
19 your report as this, kind of, slope of zero that occurs
20 at a certain level of pumping?

21 A Yes, a trend, a trend of zero.

22 Q The trend of zero. Meaning no trend up or
23 down, I guess?

24 A Yes.

25 Q Is that what you mean by a zero trend?

1 A Yes.

2 MR. WILMOTH: Did you get that?

3 THE COURT REPORTER: Yes.

4 Q (BY MR. WILMOTH) Can you help me understand
5 what the significance of that -- maintaining that trend
6 at zero is in your mind? How does that relate to the
7 objectives of compliance?

8 A Well, with that trend, when dry years come
9 along, you will tend to have much lower total amounts of
10 groundwater CBCU and a much higher probability that you
11 could be in compliance during those dry periods.

12 Q Did you conduct any statistical analysis to
13 determine that probability, the probability of being
14 able to be in compliance?

15 A No, other than -- not from those runs, no.

16 Q And if I understand your work at -- I think
17 this is your work; maybe it's Mr. Book's -- but as I
18 understand the collective work, this trend approaches
19 zero when pumping is reduced to 545,000 acres --
20 acre-feet, excuse me; is that right?

21 A I think that's correct, yes.

22 Q So is the ultimate goal of your analysis to
23 develop a groundwater pumping regime that maintains that
24 amount of pumping or less over the long term?

25 A No, I don't think that's the case. We

1 observed that the trend of zero occurred at about --
2 pumping of three NRDs and about 545,000 acre-feet per
3 year.

4 That number was very similar to the amount
5 of pumping that was reported in a letter describing --
6 or answering a question related to what level of pumping
7 would be required to maintain compliance if there were
8 no other actions --

9 Q I see.

10 A -- taken, and those numbers turned out to
11 be very similar.

12 Q And do you know what the trend in your
13 analysis shows over the first ten years of the period in
14 question?

15 A Well, it depends on what scenario you're
16 looking at. I mean, I reported a number of the values
17 for different scenarios in here, but are you -- is there
18 one in particular?

19 Q No. I'm just asking generally the trend in
20 your analysis of that first ten years.

21 A It's about -- generally, the trend was
22 about 1,000 acre-feet per year, per year. What it
23 was -- if you could only look at the first ten years,
24 I'm not sure.

25 Q Yeah. That's what I was getting at, if you

1 know the answer to that question?

2 A No. We tended to look at a longer period
3 just because we were cycling different -- repeated
4 cycles so we could see the long-term trend.

5 Q We kind of got out of whack in terms of the
6 order of your report. I'd like to return you back to
7 page 1 of the report.

8 And as I understand it, the first step in
9 your analysis was to select the baseline level of
10 pumping; is that right?

11 A Yes.

12 Q How did you go about doing that?

13 A We took the information from the IMPs as to
14 the 80 percent -- well, they reported the 1998-to-2002
15 average pumping in the IMPs, and we took 80 percent of
16 those values. And, in fact, they may have been in the
17 IMPs as well, but tabulated those and that was our
18 baseline level of pumping.

19 Q So 80 percent of the 199- -- excuse me,
20 80 percent of the 1998-to-2002 pumping?

21 A Correct.

22 Q And your report indicates that it's based
23 on the IMPs as you understand them. What is your basic
24 understanding of the IMPs at this point and what is that
25 based on? Did you analyze the IMPs and interpret them,

1 or did you defer that analysis to someone else? Who
2 gave you those parameters?

3 A As with other things, it was more of a
4 collective discussion among the group as to what those
5 were. I think -- I had looked at the IMPs, read through
6 them, as had other people. And based on the collective
7 judgment of the group, we decided to use this as a
8 baseline.

9 Q Why did you-all select the period 1995 to
10 2009 to represent the future condition?

11 A Well, if you look at page 2 of my report, I
12 spelled out the several reasons that we used that. One
13 reason was it contained both wet and dry periods.

14 Secondly, when we look at the average
15 precipitation within Nebraska during this period, it was
16 very close to the average precipitation based on the
17 same set of records of the last 50 years. So it tended
18 to be a good surrogate for what average precipitation
19 might be.

20 Also, we considered that more recent
21 periods are probably better than older periods from the
22 standpoint that acreage and applied water conditions
23 during that period are probably more indicative of
24 current practices than older periods, as I said.

25 And then we looked at the trends in the

1 CBCU that we were getting for that precipitation
2 sequence, that repeated sequence, and it seemed to be
3 similar to the trends that were being observed in some
4 of the other analyses that had been conducted by
5 Nebraska using different sequences.

6 Q These are basically the four justifications
7 provided on that page?

8 A Yes.

9 Q What's the likely rate of error in the
10 projection?

11 A The likely rate of error? I don't
12 understand what you're referring to.

13 Q Well, you've got a scenario that goes out
14 60 years, and I'm curious what the potential rate of
15 error is on that calculation.

16 A Still not following what you're asking.

17 Q How likely is it that that scenario will,
18 in fact, occur?

19 A I don't think there's a direct way to
20 evaluate that. We indirectly looked at the issue by
21 comparing to some of the runs that Nebraska had made, as
22 we talked about earlier.

23 Q Okay. With regard to the first
24 justification you've provided there, how many wet and
25 how many dry cycles are observed in that '95-to-2009

1 period?

2 A I don't think I've ever tried to count them
3 in that way. There's obviously a dry period. The
4 wetter period, I think, is more at the end of the cycle.
5 The other years are probably more normal, maybe a little
6 bit above normal; but on average, the precipitation was
7 very close for that period as compared to the last 50
8 years.

9 Q Why do you infer, with regard to your
10 second justification, that the future precipitation
11 patterns will be similar to the 50-year average that
12 preceded this period?

13 A I don't think that's what it says. It says
14 that the average precipitation within Nebraska for this
15 period was close to the average for the last 50 years,
16 so it's similar to what occurred over a longer period of
17 time.

18 Q And that's one reason why you chose to
19 utilize it?

20 A Yeah.

21 Q So why do you believe that it's appropriate
22 to utilize this average precipitation condition over the
23 next 60 years?

24 A Well, I think it's important to try to make
25 an evaluation of conditions going forward into the

1 future and looking to the past as a metric of that with
2 respect to something like precipitation is a good
3 surrogate.

4 Q And gravitating toward an average is
5 something that is of value?

6 A Well, it tends to get toward the central
7 tendency of what has been experienced historically.

8 Q And if the precipitation projection is
9 incorrect in your assumptions, how does that affect your
10 analysis?

11 A Well, it would depend on whether the
12 precipitation was wetter or drier, I guess, depending on
13 what the circumstances would be.

14 Q All things being equal, if the
15 precipitation were 130 percent of the long-term average,
16 how would that affect your analysis?

17 A Generally, what happens -- and again, this
18 is a generality that I've observed by looking at the
19 model results -- is that during wetter periods, the
20 computer groundwater CBCU will tend to go up, and during
21 drier periods, it will tend to -- I should say maybe
22 have a higher slope; during drier conditions, it will
23 tend to have a lower trend.

24 Q What happens to allocations during that
25 period, during that scenario?

1 A I don't understand what --

2 Q Do allocations tend to increase during wet
3 periods?

4 A Oh, does the amount of water available --
5 it tends to be more during wet periods than dry periods.

6 Q And if the long-term precipitation turned
7 out to be 70 percent of the values that you used as an
8 average, how would that affect your analysis?

9 A Like I said, typically, with lower overall
10 precipitation going forward, that the groundwater CBCU
11 trend would be -- tend to be lower.

12 Q But allocations are correspondingly lower
13 also; is that right?

14 A I would assume so, yes.

15 Q With regard to your third justification,
16 you explain, I think, that irrigation conditions over
17 this period are more representative of current
18 practices. What do you mean by that?

19 A What I meant by that was that the response
20 of the irrigators to the climate is embodied in how much
21 water they actually pumped in a given year. So whatever
22 current practices they're using, these more recent years
23 would be more reflective of what those responses to
24 climate would be than earlier years.

25 Q Does that mean that irrigation practices

1 tend to evolve over time to respond to hydrologic
2 conditions?

3 A They certainly can.

4 Q Why do you conclude that that evolution
5 will essentially stop, then, in 2009 and continue in a
6 static condition into the future?

7 A We didn't conclude that. In fact, one of
8 the things that we did in our sensitivity testing was to
9 look at the possibility that irrigation efficiencies may
10 increase from what they have been assumed to be in the
11 analysis.

12 Q Is that the extent of your evaluation of
13 that potentiality?

14 A In terms of actual practices, I think
15 that's correct.

16 Q And then with regard to your fourth
17 justification, I know we spoke about these Nebraska
18 runs. Did you ever contact anybody at the Department of
19 Natural Resources in Nebraska to discuss these runs with
20 them?

21 A No.

22 Q But it's your understanding that the
23 Department conducted those runs, right?

24 A That was my understanding. These were the
25 runs that were presented in -- I think it was in 2006 --

1 or this one set was anyway, in 2006, in a document that
2 we had obtained. So that was one set of the runs.

3 The other set was one that we found in our
4 review of the information provided by Nebraska.

5 Q Would you have conducted similar analyses
6 if the Department had not provided those?

7 A I don't know.

8 Q If the Department were to indicate that
9 they would not use the runs in the manner in which you
10 used them, would you abandon that practice?

11 A I don't understand the question.

12 Q Well, as I understand it, you reviewed some
13 runs that were contained on a hard drive that we
14 litigants collectively refer to as the data dump and
15 selected them to support your argument.

16 I understand you didn't know the context in
17 which those were developed, and I understand you believe
18 they were developed by the Department. You don't know
19 whether you would have developed them directly.

20 And so my question is, if the Department,
21 the author of the runs, indicated that they would not
22 utilize those runs for the purposes that you utilized
23 them for, would you abandon your practice of utilizing
24 them?

25 A No.

1 Q Does your 60-year projection account for
2 any changes in cropping patterns?

3 A No.

4 Q Does it consider any potential climate
5 change?

6 A It considers changes in climate conditions
7 over time.

8 Q Just in your annual variability or
9 long-term climate change in the sense of long-term
10 drying or long-term increases in precipitation?

11 A Our run, as I've described the report,
12 repeats these four -- these cycles four times.

13 Q Okay. A bit further on in your report, you
14 note that several geographic areas were selected to
15 determine the impact of pumping reductions. Who
16 selected these areas?

17 A These were -- there were some areas that we
18 had utilized earlier, in some of our earlier work, in
19 looking at different widths of areas along the various
20 stream networks. So these were things that we had
21 utilized in the past.

22 And so I don't know if there was any one
23 person who selected them, but collectively, especially
24 between Sam and myself, we looked at alternatives.

25 Q What criterion did you use to select these

1 areas?

2 A Basically, the criteria was whether or not
3 they were within a certain distance of the stream
4 corridors.

5 Q Any other criteria?

6 A Not for those. We did also look at the
7 10-2 and 10-5 areas that Nebraska had developed as well.

8 Q What was your thinking in terms of the
9 relationship between this area and your goals?

10 A Well, the general concept is that we would
11 expect areas nearer to the stream corridors to have a
12 more rapid response in terms of impacts on the --
13 potential impacts on the stream system in terms --
14 related to changes in pumping that might occur in those
15 areas.

16 Q Were you attempting to identify the
17 narrowest possible zone with the highest impact on
18 streamflow?

19 A No.

20 Q Aside from the impact on groundwater CBCU,
21 did you have any other factors that were relevant to
22 your consideration?

23 A You mean besides the relative position?

24 Q Yes, aside from the geographic region.

25 Actually, I think you might have already answered that.

1 I'm sorry.

2 You indicate you selected the nominal -- a
3 nominal 5-mile corridor. What initial tests are you
4 referring to in your report when you say you did some
5 initial tests to develop that corridor?

6 A We just looked at the sort of long-term
7 impact that you could get from comparing reductions in
8 each of the different geographic areas over the longer
9 term.

10 Q Are those initial tests set forth in the
11 report or provided with the supplemental materials?

12 A I'm not sure. I'd have to check.

13 Q Why did you end up rejecting the 7-mile
14 corridor?

15 A I think it had to do mainly with whether or
16 not the 5-mile corridor encompassed enough area of
17 pumping reduction that we could achieve reduced
18 groundwater CBCU out several decades into the future and
19 that that was sufficient to get it sort of down into the
20 overall magnitude to go out 5 miles.

21 Q And who identified the threshold that you
22 were trying to hit through these processes?

23 A Well, there wasn't a specific threshold.
24 In fact, that's why we looked at different levels of
25 reduction to see what could be accomplished at different

1 levels for different geographic areas.

2 Q There wasn't a threshold of groundwater
3 CBCU that you were trying to maintain?

4 A Not specifically, no. There was sort of a
5 back-and-forth process with Mr. Book because he was
6 integrating these results into his analysis, and that
7 led ultimately to the selection of the 5-mile corridor
8 and the 90 percent run that we made.

9 Q And what does the 5-mile corridor and the
10 90 percent run translate to over the long term as far as
11 the groundwater CBCU?

12 A Well, that's shown in various runs, but if
13 you look at -- if you look at Figure 2, in the blue
14 curve, that's the projection of the impact on
15 groundwater CBCU in the baseline. And then you can see
16 in the other curves what happens when the pumping within
17 that corridor is reduced.

18 Q So with the 100 percent pumping reduction,
19 you're staying below a CBCU of about, what, 180,000?

20 A Well, it varies over time. As you can see
21 here, there's this upper trend after an initial drop,
22 and it sort of ends up at about 200,000 at the very end,
23 but . . .

24 Q But there's no year there in which
25 groundwater CBCU exceeds, what, 190,000 acre-feet?

1 A Well, if you look at -- if you look at the
2 last year in the cycle, it's -- actually, let me look at
3 the table. It looks like the last year is 198,000.

4 Q So I guess I'm asking a chicken-and-the-egg
5 question here, but did you conduct these runs to ensure
6 that CBCU stayed below that level or did CBCU stay below
7 that level as a consequence of these runs?

8 A Well --

9 Q Were you attempting to achieve this result,
10 is my question?

11 A What we wanted to know was, if we reduced
12 the pumping in that corridor by different levels, how
13 would that affect our calculation of the trends going
14 forward, given the repeated cycles of climate we were
15 using.

16 And then based on that, that information
17 would feed back into Mr. Book's evaluation of what that
18 meant. And then we actually made a supplemental run at
19 90 percent reduction after that discussions -- those
20 discussions.

21 Q But you-all, meaning yourself and
22 Mr. Perkins, didn't have any predisposed notion about
23 what the ultimate CBCU needed to be?

24 A No.

25 Q So then as I understand it, the model was

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1 used to calculate potential future impacts to CBCU and
2 IWS. Is that a standard use of the groundwater model,
3 to calculate future impacts?

4 A Well, it's a standard use of the model to
5 calculate groundwater CBCU and IWS. We applied it to --
6 applied the model to look at potential future impacts.

7 Q Is that application the standard use of the
8 model; is that why it was developed?

9 A The model was developed to calculate
10 groundwater CBCU and IWS. We applied it to look
11 forward, look at potential impacts into the future.

12 Q So was the model developed to look at
13 potential impacts into the future?

14 A The model was developed to calculate
15 groundwater CBCU and IWS.

16 Q So that's a no?

17 A No, that's not a no.

18 Q Okay.

19 A That's what it was used for -- or that's
20 what it was constructed for, to make those calculations.

21 Q Okay. Was it -- was the model constructed
22 to make calculations of IWS and CBCU into the future?

23 A That wasn't the purpose when the model was
24 being developed. The model can be used to do that.

25 Q And that's how you used it?

1 A Yes. And that's how others have used it.

2 Q Who has used it in that fashion?

3 A Nebraska has used it in that fashion.

4 Q In regard to these runs that you referred
5 to in your report?

6 A Yes.

7 Q Do you believe there are any limitations on
8 the model's ability to act as a forecasting tool?

9 A I can't think of any particular limitations
10 of the model itself.

11 Q Does the model have a predictive component?
12 Does the model predict outcomes, or does it just
13 generate outputs from inputs that are based on people's
14 predictions?

15 A The model makes calculations based on the
16 information you provide in the input files.

17 Q And those calculations, then, are as good
18 as the input provided?

19 A Those calculations are dependent on the
20 inputs that are provided.

21 Q I want to turn your attention to Table 1 at
22 page 10 of your report or KS 691. Can you tell me what
23 this table represents?

24 A Yes. This represents the calculation of
25 the Nebraska Groundwater CBCU and the calculation of the

1 IWS credit using the RRCA procedures for the years 2010
2 to 2069 using the conditions that we described in our
3 report going forward.

4 Q And turning your attention to the first
5 row, year 2010, there's a groundwater CBCU figure of
6 2,000 -- excuse me, 219,024 acre-feet; is that right?

7 A That's what it says, yes.

8 Q Do you know what the actual figure is for
9 groundwater CBCU in 2010?

10 A You mean do I know what -- the one that was
11 calculated by the RRCA?

12 Q Yes.

13 A No, I don't -- well, I know it somewhere,
14 but I don't remember what it is off the top of my head.

15 Q If I told you it was roughly 210,000
16 acre-feet, would you be surprised?

17 A No.

18 Q So assuming for the sake of argument that
19 it were 210,000 acre-feet, doesn't Table 1 in this
20 entire analysis start with a fairly fundamental error?

21 A No, I don't think so.

22 Q Why not?

23 A Because we're looking at overall trends and
24 overall levels that you might expect to get into the
25 future.

1 Q So regarding trends in the future, if the
2 starting year is off by 10,000 acre-feet, wouldn't that
3 error continue to propagate itself throughout the future
4 conditions?

5 A Not necessarily.

6 Q Why not?

7 A Because those kind of things die away over
8 time.

9 Q So is your opinion that over the 60-year
10 period, that 10,000 acre-foot, roughly, difference would
11 be irrelevant?

12 A It could be.

13 Q Could it not be?

14 A Depends on what you call relevant or
15 irrelevant. I don't think it affects the conclusions
16 that we've drawn in any way.

17 Q Do I understand that this Table 1 serves as
18 a baseline for Tables 2, 3 and 4?

19 A Yes, that's correct.

20 Q And you have no concerns about the impact
21 of this potential discrepancy on any of those tables?

22 A Not in terms of the conclusions that we
23 drew.

24 Q How did you select the pumping reduction
25 amounts you employed to create Tables 2 through 4?

1 A We basically wanted to look at a range of
2 values going from 100 percent, and then we just
3 decreased in increments over that, down to 80 percent,
4 60 percent in Tables 3 and 4, so that we would have sort
5 of a -- a ballpark of results that we could look at.

6 We, actually, I think even -- might have at
7 one time used lower percentages as well.

8 Q Then with regard to Table 5, you note that
9 Spronk Water Engineers -- or I should say discussions
10 with Spronk Water Engineers led to this Table 5. What
11 was the nature of those discussions?

12 A These were discussions that, as best I can
13 recall, revolved around what level of CBCU they felt
14 might be necessary a few decades into the future. And
15 based on those discussions, it was decided to run an
16 intermediate reduction of 90 percent, as between the 100
17 and the 80.

18 Q Do you know why that decision was made?

19 A Because we wanted to more closely target a
20 specific reduction amount.

21 Q I'm not sure I understand your statement.
22 You wanted to target a specific reduction amount of
23 acres?

24 A No. Looking at the 100 percent and the
25 80 percent, it indicated that looking several decades

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1 out, that as a result of Mr. Book's work, we needed to
2 be somewhere in between those two in terms of the amount
3 of reduction.

4 So we used a 90 percent to give us a better
5 trend of what the 90 percent would look like -- or
6 something in between those two would look like.

7 Q So as a result of Mr. Book's work, you
8 identified something that you were trying to achieve.
9 Can you tell me what that thing was?

10 A It was generally the level of groundwater
11 CBCU that would occur in say the third low period cycle.

12 Q So this would be the 45th year forward or
13 the --

14 A I think that occurred in --

15 Q Would that be the 30th year forward?

16 A I think it occurs in the 38th year. Yes,
17 the 38th year.

18 Q So if I understand your --

19 A Anyway, that was generally the cooperation.

20 Q So if I understand then, you ran some
21 scenarios; you received some feedback from Mr. Book; and
22 you then ran a new scenario, which was designed to
23 achieve a certain level of groundwater pumping in your
24 38th; is that a fair characterization?

25 A No. I think I might have misspoke on the

1 38. It looks like it's more like approximately 40
2 years. Let me go back.

3 It might have been 38; I just don't recall.

4 But the idea was that we wanted to get a trend that was
5 between the 100 and the 80 percent reduction, and so we
6 picked 90 as being between those to get additional input
7 that he could factor into his calculations.

8 Q And do you know what Mr. Book was trying to
9 achieve in that 38th year?

10 A Not precisely. Generally speaking,
11 something on the order of 220,000 acre-feet or
12 thereabouts or 210-. I can't remember the number off
13 the top of my head.

14 Q And do you know why that number was
15 significant?

16 A I think it had to do with what level of
17 CBCU could be tolerated during a dry period at that
18 point in time.

19 Q And by "tolerated," do you mean -- or what
20 do you mean by "tolerated"?

21 A That that's sort of the level you would
22 need to have a good chance to be in compliance.

23 Q In that year?

24 A During that period.

25 Q Then you also, on page 7, note that

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1 Mr. Barfield requested that you conduct several

2 additional calculations. Can you tell me why

3 Mr. Barfield made that request?

4 A I can't tell you specifically why he made

5 it, but my recollection was, of the discussions that the

6 group was having, was what might be the impacts of the

7 implementation of some of the scenarios that we could

8 envision looking at the IMPs and that he wanted to look

9 at what the outcome of some possibilities would be under

10 scenarios that might evolve from the implementation of

11 those IMPs.

12 Q Did you receive any limiting instructions

13 in terms of your performance of those runs, or did you

14 exercise some discretion in developing what they looked

15 like?

16 A Well, I think -- I think the nature of the

17 runs was, again, kind of a collective result of

18 discussions among the group about the IMPs and what

19 might transpire as a consequence of those, and that

20 based on those, these were selected.

21 Q And what three scenarios did you employ?

22 A Well, the one was, we reduced the overall

23 pumping to an average of 70 percent -- 75 percent, I

24 should say, of the 1998-to-2002, so that was -- that was

25 one of them.

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1 Then we did another scenario where we
2 removed pumping, as it says here, 100 percent
3 curtailment from a 10-percent/2-year response area for
4 the entire period.

5 Q Sure.

6 A And then we had another one where we cycled
7 that reduction during the period corresponding to the
8 historical years 2002 to 2007. So during those years,
9 the pumping from the 10-percent/2-year area would have
10 been 100 percent curtailed for that period. And then --

11 Q For that period?

12 A -- back to normal pumping.

13 Q And these were selected through a
14 collaborative effort?

15 A Yes.

16 Q Do you know why those were specifically
17 selected? Was that to try and emulate the IMPs? Is
18 that what you meant when you were giving me my answer to
19 why Mr. Barfield directed you to do these?

20 A It was to try to evaluate what the
21 potential impact could be if certain aspects of the
22 IMPs --

23 Q I see.

24 A -- might occur. In terms of how long, we
25 discussed various durations and decided that looking at

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1 a five-year period from -- or a six-year period from
2 2002 to 2007 was the one that he wanted to ultimately
3 use.

4 Q Did you conduct any scenario that combined
5 the 75 percent reduction and the temporary curtailment
6 in the 10-2 area, or were each of these looked at in
7 isolation?

8 A I don't remember if we did that or not. We
9 may have at one point in time. I don't remember.

10 Q But it's not reflected in this report?

11 A It's not in the report, no.

12 Q Okay. Do you know if any of these
13 scenarios account for any additional compliance efforts,
14 such as surface water curtailment or purchases and
15 transfers of surface water rights?

16 A Well, this is only the groundwater --

17 Q Okay.

18 A -- evaluation.

19 Q All right.

20 MR. WILMOTH: All right. Why don't we hit
21 lunch a little early, and maybe we could make it back
22 around 12:45 or -- give or take a few minutes.

23 MR. DRAPER: Okay.

24 (Recess taken from 11:30 a.m. until
25 12:53 p.m.)

1 Q (BY MR. WILMOTH) Welcome back,
2 Mr. Hamilton [sic]. I wanted to direct your attention
3 to Exhibit 5, which is what I call your second report,
4 and page 1, if you would, the section entitled Method of
5 Analysis.

6 Are you with me?

7 A Yes.

8 Q On the last line of that paragraph, I
9 understand from that that you applied average pumping
10 amounts from 1998 to 2002 across acreage as of 2006; is
11 that right?

12 A That's correct -- well, sorta correct.

13 Q Could you explain to me how I would be
14 incorrect in that or how you actually did that process?

15 A Well, what we did was we -- we looked at
16 the pumping that had occurred from 1998 -- well, we
17 looked at the pumping that had occurred from 1995 to
18 2009, and then we first scaled a portion of that pumping
19 up until 2007 -- or up through 2006 such that the
20 average pumping for that scaled sequence of pumping over
21 the whole 15-year period would equal the average pumping
22 numbers of 80 percent of the 1998-to-2002 values. That
23 was the first step --

24 Q Okay.

25 A -- in that process. And then that gave us

1 an irrigation depth for each year.

2 Q Okay. And then can you explain to me the
3 meaning of the last sentence on this paragraph?

4 A Then these irrigation depths were then
5 applied -- the irrigation amount in terms of how many
6 inches of water to be applied were applied to the
7 acreages in 2006. And then adjustments were made
8 through time so that the average pumping for the entire
9 15-year period would equal the amounts shown in those
10 last two sentences and the total depth of pumping over
11 any five-year period would not exceed the allocations
12 described in the rules and other places.

13 Q That's where we get to page 2, that second
14 part?

15 A Yes.

16 Q Okay. I want to talk about that in a
17 moment.

18 But with respect to your selection of 2006
19 as the appropriate year for applying your volumes to
20 irrigated acreage, how did you come about 2006?

21 A It seems to me, if I remember correctly, we
22 kind of looked at the conditions from 2006 through 2009,
23 and 2006 looked like a -- a reasonable amount in terms
24 of any variation in those acreages, so that was used as
25 the value to apply the depths of irrigation to in the

1 subsequent adjustments of the pre-2006 years.

2 Q I'm going to hand you a document that I
3 will represent to you we generated using the backup data
4 provided in your report. You don't have -- you can
5 accept that subject to confirmation.

6 But I'd like you to look at that and tell
7 me if that looks generally consistent with your
8 recollection of those numbers.

9 A I think that generally -- generally looks
10 right.

11 MR. WILMOTH: We'll mark that as Exhibit 6.

12 (Deposition Exhibit 6 was marked.)

13 Q (BY MR. WILMOTH) Given this downward trend
14 from 2006 to 2009, why not use the newer data?

15 A Well, I don't think the --

16 Q Give you this back?

17 A Yeah. I don't think the precise acreages
18 is as critical as the amount of the pumping and the
19 depths of pumping that we assumed because what we did is
20 we adjusted those to maintain the averages in terms of
21 the amount of pumping.

22 So the only impact of, say, a smaller area
23 would be that there would actually be less precip
24 recharge on irrigated land and the impacts would
25 probably be even higher.

1 Q As you carry that through, though, doesn't
2 that affect the scope of the areas you consider subject
3 to potential shutdown conditions, the geographic scope?

4 A Well, the shutdown is based on whatever
5 pumping is available within a particular geographic
6 area, and it is basically shut down incrementally. So I
7 don't think it would really affect that in any way.

8 Q So this calculation has nothing to do with
9 that calculation?

10 A Well, I don't think it would affect the
11 series of runs that we made in terms of the amounts of
12 pumping that we determined would have to be reduced.

13 Q Okay. So what's the real import of
14 selecting a particular year to distribute those amounts
15 over an irrigation -- an acreage number? Why did you do
16 what you did there in the last sentence of that
17 paragraph?

18 A Because in going forward, trying to make an
19 estimate of what the potential future conditions might
20 be, you need to select an irrigated area. We wanted
21 something that was more current and roughly similar to
22 what the more recent years showed, and that's what this
23 value, 2006, was.

24 Q You're not suggesting --

25 A It was sufficient, in my view, for the

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1 purposes that we were using it, to make these
2 projections in the future.

3 Q So it didn't matter if you chose '06 or
4 '09?

5 A It will matter some, although if we go and
6 apply the pumping to the smaller acreage, the impacts
7 will actually be higher.

8 Q What impacts are you referring to?

9 A The impacts on groundwater CBCU.

10 Q Then you spoke to me -- or alluded to this
11 second step in your process, which I understand is on
12 page 2?

13 A Uh-huh.

14 Q That sentence --

15 A Yes.

16 Q That begins: "A further" -- as a further
17 constraint or -- "A further constraint, as we understand
18 the IMPs." Can you explain to me the nature of that
19 constraint, as you understand it, and how you applied it
20 in this case?

21 A The constraint, as we understand it, is
22 that the NRDs have to -- are allocated a certain depth,
23 an average irrigation depth over generally a five-year
24 period.

25 So we looked at the pattern that was

1 created by applying Step 1 and then looked at the
2 cumulative irrigation depths over a five-year period and
3 made adjustments in some of the years so that in any
4 given five-year period, that allocation would not be
5 exceeded.

6 Q So is that what you refer to when you talk
7 about the "allocations of water to irrigated acreage are
8 limited"?

9 A Yes. It was our understanding that over a
10 five-year period, the depth of irrigation was limited to
11 a certain average amount, which, for example, if it was
12 13 inches over five years, would be a total of
13 65 inches.

14 Q And how many years did you look at, a
15 five-year period?

16 A We looked at the entire 15-year period and
17 made sure that in any given five-year period within that
18 15-year period, that that would not be exceeded.

19 Q Okay. And then does the Table A that you
20 provided us this morning represent these fully adjusted
21 irrigation depths that I think you used to produce
22 Table A for the baseline? Is that what Table A
23 represents?

24 A Yes. Table A is the irrigation depths that
25 we had adjusted through this process and that --

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1 Q The end result --

2 A The end result.

3 Q -- of that process?

4 Okay. I'd like to turn you now to page 5

5 of your report, which is KS 686. That last paragraph,

6 do I understand this paragraph to mean that the pumping

7 reduction to 545,000 acre-feet is consistent with what

8 you refer to here as Option 1 that Nebraska developed?

9 A That was my understanding.

10 Q What did you base that on?

11 A On the descriptions in the presentation

12 materials that were associated with describing what

13 Option 1 was.

14 Q Are those the presentations to the NRDs

15 that you reference here?

16 A Yes.

17 Q Were there any other options developed?

18 A There were Options 2 and 3.

19 Q Did you have occasion to analyze those

20 options?

21 A I certainly read through them. I don't

22 know what you mean by "analyze" them.

23 Q Well, I infer from this that you conducted

24 some analysis of Option 1 to draw this conclusion, and

25 I'm wondering if you analyzed Option 2 and 3 in that

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1 same fashion?

2 A Well, you couldn't really analyze the other
3 options in that same fashion.

4 Q Why so?

5 A Because Option 1, as I understood it, was
6 the amount of pumping that would be necessary to -- the
7 amount of pumping reduction that would be necessary to
8 achieve compliance in every year going forward, and so
9 there was a specific amount of pumping that they had
10 determined would be necessary to do that.

11 And then Option 2 and 3 were different, in
12 that they were, as I understood them, designed such that
13 they would maintain Compact's compliance in most years,
14 but not all years.

15 Q 2 and 3 would not maintain compliance in
16 all years?

17 A Correct.

18 Q And your understanding is that's what they
19 were designed to accomplish?

20 A Well, that's what the description said they
21 would accomplish.

22 Q So you didn't actually conduct any analysis
23 of Options 2 or 3?

24 A No, because certain components of what
25 might occur under those options were unknown.

1 Q Okay. So can I infer then that you have no
2 opinion as to whether Options 2 or 3 are functionally
3 equivalent to Option 1?

4 A Well, I don't think they're functionally
5 equivalent to Option 1.

6 Q On what do you base that view?

7 A Well, I base it, I guess in part, on the
8 general analysis that we did, but also in part on the
9 statement that's made in the description of the options.

10 Q What's the general analysis that you made?

11 A Looking at the overall trends over time of
12 increasing depletions under different levels of pumping
13 that we presented in this report.

14 Q So is it your opinion that the only way to
15 ensure long-term Compact compliance is to reduce
16 groundwater CBCU to this 545,000 acre-foot volume?

17 A I think if you want to do it in every year
18 and you want to be quite certain about it, that's
19 probably the level you would have to go to.

20 Q In his expert report, Mr. Barfield, on
21 page 1, states that: Kansas remains open to equivalent
22 remedies to ensure future compliance, but Nebraska has
23 proposed none.

24 And you're welcome to read that if you
25 would like. But did you conduct any analyses that were,

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1 in your view, hydrologically equivalent to Option 1?

2 A If I understand your question, you're
3 saying did I attempt to determine an alternative that
4 would be hydrologically equivalent to Option 1?

5 Q Yes.

6 A No.

7 Q Did you evaluate any other alternatives
8 that you would consider to be equivalent remedies to
9 what Kansas has proposed in this action?

10 THE DEPONENT: Could you read that back,
11 please.

12 (The last question was read.)

13 A No.

14 Q (BY MR. WILMOTH) I want to return to your
15 future hydrology scenario, your 60-year projection.
16 That differs from the projections you used in the
17 arbitration preceding this litigation, doesn't it?

18 A It's different in terms of the sequence of
19 years that we used, yes.

20 Q Why did you elect to change that projection
21 period or that sequence of year?

22 A Well, as I described in my report, among
23 the reasons that we selected 1995 to 2009 was that -- a
24 couple of reasons, I guess. One, that it was more
25 current, and so this new period that we used was more

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1 current than the period we had used before.

2 And secondly, it -- it matched -- or not

3 matched -- it was, I think, more similar to the

4 long-term average precipitation conditions perhaps than

5 the earlier one.

6 Q And the projection you used in the

7 arbitration differed from the projection you used in

8 support of the petition for certiorari, did it not -- or

9 excuse me, confusing cases -- petition for the original

10 action, did it not?

11 A If I'm remembering that one correctly, that

12 one used a constant pumping condition, if I remember

13 right. I don't have a clear recollection of that one,

14 but --

15 Q So you --

16 A -- so it would be different in that

17 respect.

18 Q Okay. Do you know if it's different from

19 what you're using today?

20 A Well, we're not using a constant pumping

21 amount going out. The pumping amount that we use in any

22 given year is an attempt to tie it more to the

23 hydrology.

24 Q So what would be the reason for selecting

25 that method rather than using a constant as you did in

1 the petition?

2 A Well, I think there is some correlation
3 between the amounts of water that is pumped or people
4 would like to pump depending on what the climate is
5 and -- in other words, when it's drier, there would be a
6 need or desire to pump more water versus when it's
7 wetter. And that attempts to capture some of that
8 relationship.

9 Q I tried to get at this before, but I don't
10 know if my question was well-phrased.

11 But is there any way to determine the rate
12 of error between what is assumed for any given future
13 scenario and what might actually occur?

14 A Well, if by the term "rate of error" you're
15 talking about the difference between a projected outcome
16 and what actually occurred or -- there is no way because
17 you don't know what that is, if that's what you mean by
18 rate of error.

19 Q It is.

20 MR. WILMOTH: I thank you. I think that's
21 probably all we have then. Pete's got nothing?

22 MR. AMPE: No.

23 MR. WILMOTH: You want to take a break,
24 John?

25 MR. DRAPER: Yes, please.

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1 MR. WILMOTH: Okay.

2 (Recess taken from 1:13 p.m. until

3 1:19 p.m.)

4 MR. DRAPER: Okay. We have no further

5 questions.

6 MR. WILMOTH: All right. We will see you

7 bright and early tomorrow, Mr. Book.

8 (Whereupon, the deposition concluded at

9 1:19 p.m.)

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1 I, STEVEN P. LARSON, do hereby certify that
2 I have read the foregoing transcript and that the same
3 transcript and accompanying correction sheets, if any,
4 constitute a true and complete record of my testimony.

5

6

Deponent

7

8

9 ☐ No Changes ☐ Amendments attached

10

11 Subscribed and sworn to before me this

12 _____ day of _____ 2012.

13 My commission expires: _____

14

Notary Public

15

16 sd

17 State of Kansas v. State of Nebraska, et al.

18

19

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21

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1 STATE OF COLORADO)

2)SS. REPORTER'S CERTIFICATE

3 COUNTY OF ARAPAHOE)

4 I, K. MICHELLE DITTMER, do hereby certify

5 that I am a Registered Merit Reporter and Notary Public

6 within the state of Colorado; that previous to the

7 commencement of the examination, the deponent was duly

8 sworn by me to testify to the truth.

9 I further certify that this deposition was

10 taken in shorthand by me at the time and place herein

11 set forth and was thereafter reduced to typewritten

12 form, and that the foregoing constitutes a true and

13 correct transcript.

14 I further certify that I am not related to,

15 employed by, nor counsel of any of the parties or

16 attorneys herein, nor otherwise interested in the

17 result of the within action.

18 I further certify reading and signing not

19 requested pursuant to CRCP Rule 30(e).

20 In witness whereof, I have affixed my

21 signature this 27th day of February, 2012.

22

23

24

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7
8 Case Name: State of Kansas v. State of Nebraska, et al.
Case No.: No. 126, Original
9 Deposition of: STEVEN P. LARSON

10 The deposition in the above-entitled matter is ready for
reading and signing. Please attend to this matter by
11 complying with ALL blanks checked below.

12 _XX_ arranging with us at (303) 696-7680 to read.
and sign the deposition in our office.

13
OR (if applicable),

14
XX have deponent read your copy; signing attached
15 original signature page and any amendments
sheets.

16
_____ read enclosed deposition, sign attached
17 signature page and any amendment sheets.

18 _XX_ within 30 days of the date of this letter.

19 Please be sure that the signature page and accompanying
amendment sheets, if any, are signed before a notary
20 public and returned to our office at the above address.

21 If this matter has not been taken care of within said
period of time, the deposition will be filed unsigned
22 pursuant to the Rules of Civil Procedure.

23 Thank you.

Enclosures:

24 cc: Tom Wilmoth, Esq; Peter J. Ampe, Esq.

25

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3 February 27, 2012

4 TOM WILMOTH, ESQ.
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6

7 Re: State of Kansas v. State of Nebraska, et al.
Deposition of: STEVEN P. LARSON

8 Dear Mr. Wilmoth:

9 ___ Previously filed. Forwarding signature page and
amendment sheet(s).

10 ___ Signed, no changes.

11 ___ Signed, with changes, copy of which is enclosed.

12 ___ No signature required.

13
14 _XX_ Reading and signing not requested pursuant to CRCP
Rule 30(e)

15 ___ Signature waived.

16 _XX_ Forwarding original transcript unsigned; signature
17 page and/or amendments will be forwarded if
received.

18 ___ Original exhibits included in ongoing notebook
19 and will be filed with counsel at conclusion of
discovery.

20 Enclosures: (As above noted)

21 cc: John B. Draper, Esq.; Peter J. Ampe, Esq.

22

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